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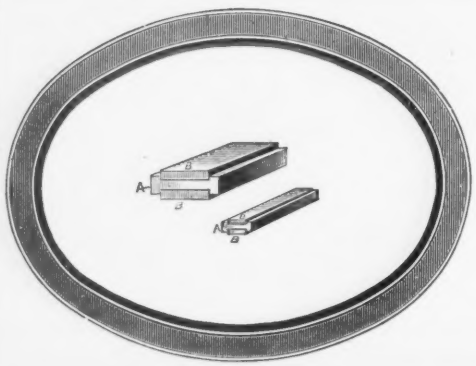

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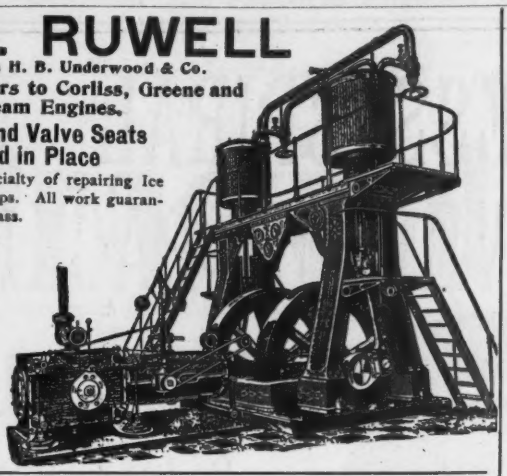

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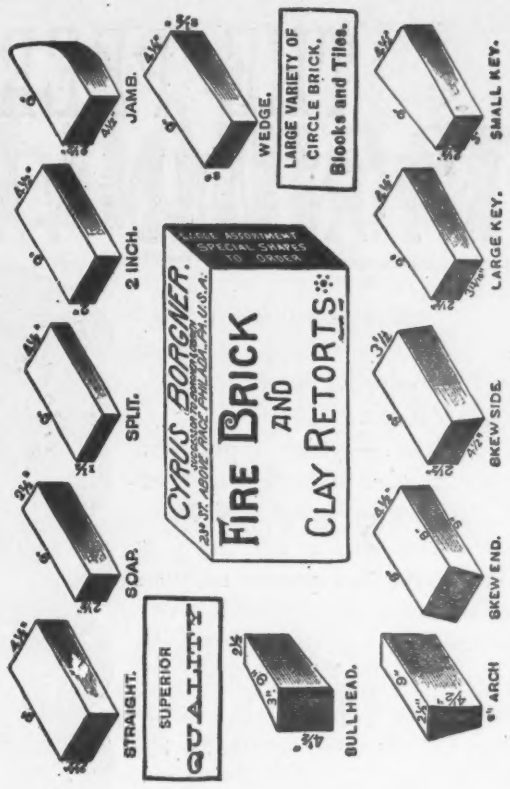

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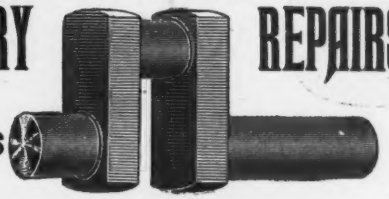

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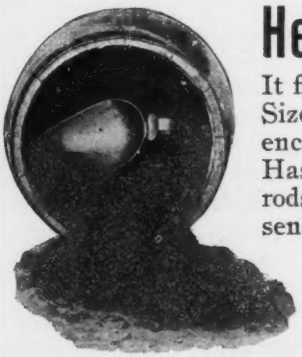

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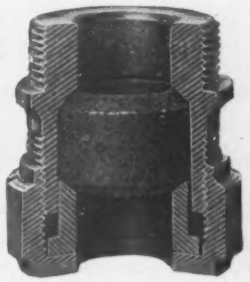

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Care and Operation of Dynamos and Motors

In what follows on the operation of motors and dynamos, it is assumed that the machine is properly designed and of sufficient capacity for the work it is called upon to perform. For satisfactory operation, the machine must be connected with an appropriate circuit and one of the voltage or amperage for which the machine was designed. Further it is assumed that the mere mechanical details have been looked to, such as proper foundation, proper alignment with shafting, and good lubrication. Only electrical trouble will be treated.

If trouble be detected, a machine should be at once stopped to prevent further trouble. In central generating stations, one of the most positive rules is not to shut down while any possible means is left to keep running. In such plants there are always one or two units held in reserve, and one of these may be started and substituted for a machine developing a fault so that the latter may be shut down and its fault remedied.

Sparking at the brushes is the most general trouble, and it has more causes than any other. The brushes must make good contact with the commutator, they must be true, and have good contact surface. The commutator must be clean. Any collection of carbonized oil is sure to cause sparking. A very thin layer of good oil, free from dust is advantageous. On a bipolar machine the brushes must be diametrically opposite on a four pole, exactly 90 degrees apart, etc. This condition must be attained while the machine is at rest, either by actual measurement or by counting the commutator bars between each brush. If the brushes of one set are "staggered" they may cover too much armature circumference and cause sparking. The brushes must be set at the proper point. This is accomplished while the machine is in operation under its required load. The rocker arm, which carries all the brush holders, is moved carefully back and forth until the point of minimum sparking is found. Sometimes there is quite an arc of movement in which sparking is not observed. The brushes should then be set at the center of this arc, since heating occurs when the brushes are off the proper commutating point, even if sparks be not seen.

Sparking may be due to fault in the commutator. A high-bar, a low-bar, or flat, projecting mica, rough or grooved surface, eccentricity, or any condition of surface which causes the brushes to vibrate and lose contact with the commutator will surely cause sparking. If sparking be allowed to go without correction it will pit the commutator and aggravate these conditions. If the irregularity of surface be slight, it may be cut down by sandpaper (never emery) held in a block cut to fit the commutator. If the surface be very bad, it must be cut down by a machine. A small armature may be swung in a lathe; but a large one must be left in its own bearings, and a tool held against the commutator by some special device. A perfectly true commutator may act eccentrically toward the brushes because of wear in the shaft bearings. New bearings will remedy this fault.

If a coil of the armature be short-circuited, periodic sparking may result. The coil is liable to burn out if the machine is not immediately stopped. The short circuit may occur from breakdown of the insulation within the armature, in which case rewinding is necessary; or it may be caused by metal chips or the like at or near the commutator, in which case the cause can be easily removed. When a coil is broken very violent sparking occurs, since half the armature current is broken every time the commutator bar connected to the broken coil passes from under a brush. Such a break may occur within the armature, requiring rewinding; but it is more likely to occur where the coil end is attached to the commutator bar lug. If the break be at this place, the wire needs but to be screwed or soldered to the lug and the machine is repaired.

If the field of a motor is too weak, sufficient counter E. M. F. is not generated, and excessive current flows and causes sparking. The weakening of the fields may occur from a short circuit in the field coils or two or more grounds between the field coils and the pole piece, or by a broken field circuit (shunt coils) which reduces the magnetism to almost zero. In any case, unless the trouble is to be found external to the coils, rewinding is necessary.

Heating of machines is another frequent source of trouble. The limit of temperature that may be allowed in the bearings depends on the flashing point of the lubricant used, but a well designed and lubricated bearing ought always to run cooler than the commutator or armature. The limit of temperature that may be allowed in the armature depends on the "baking"-

point of insulation used, and also on the melting-point of the solder used if the coil ends are soldered to the commutator lugs. A good general rule is this: If you can hold your hand on any part of the machine for more than a few seconds, that part is not dangerously hot. Of course metal feels warmer than insulating cotton for the same temperature, and allowance should be made for this. If a burning smell or smoke comes from a machine, the safe temperature limit has been far exceeded, and the machine should be shut down at once. This indicates a serious trouble—a short circuit or a hot bearing probably.

If the trouble arises from the bearings the ordinary mechanical precautions of cleaning, aligning, lubricating, etc., will generally cure it. Never use water to cool hot bearings. If water gets into the windings of either the field or the armature, short circuits will occur and ruin the machine. It must not be assumed that because one part of a machine is hot the trouble lies with that part. Heat is quickly conducted all over a machine; and when heat is detected in one place the machine should be felt all over, the hottest part probably being the part at fault. The brushes of a machine should not be set too tight, for besides reducing the efficiency greatly, they cause much heat from friction. The commutator should not be more than 5 degrees C. hotter than the armature.

Machines that operate on constant pressure circuits are liable to overheat because of too much current flowing through some parts of them. This may result from overloads, in which case the remedy is obvious, or because of short circuits in the machines, in which case rewinding is generally necessary. In the case of constant potential generators a short circuit of the mains will produce a sudden and severe overload, which can only be remedied by tracing out the lines and removing the short circuit.

When a machine makes an unwarranted amount of noise it usually indicates the need of attention. Carbon brushes chatter and spark sometimes when the commutator is sticky; the action being something like a bow on a violin string. Cleaning the commutator will cure this. Humming and vibration result when the revolving parts are not revolved about their centre of gravity. This may be because of faulty construction or warping after completion. If the fault be with the pulley, it may be turned out or counterweighted. If the shaft be sprung it may be straightened or a new one used. If the armature core or windings be out of balance, there is not much help for it. Slower speed will reduce the noise from this cause.

Noise may occur from the armature rubbing or striking against the pole faces. This is a serious matter, and if not immediately attended to results in the destruction of the armature. It is caused generally by wear in the shaft bearings, in which case new brasses will remedy the trouble. Sometimes it results from a sprung shaft, in which case the shaft must be either straightened or replaced. A rattle produced by loose collars, bolts, nuts, or connections would indicate that these parts needed setting up or adjusting.

If a motor revolves too slowly, it may be because of an overload of mechanical work, because of excessive friction in the machine, or because of the armature rubbing against the pole face. A variation in the pressure supplied to a motor causes a variation in speed. If the field magnetism be too weak the motor will revolve too fast when not loaded, and too slow when under full load, and will take excessive current. A weak field may be caused by a short circuit which cuts out some or all of the field turns, or by a broken field circuit. If the load be removed from a series motor on a constant current circuit it will race badly unless its fields coils are shunted. Practically such a motor should not be used in any position where it may be suddenly relieved of its load, as by the slipping of a belt. A shunt motor, whose fields are not excited, will run either forward or backward when a current is allowed to flow in the armature, according to the relative magnitudes and directions of the residual magnetism and the armature re-actions. Ordinarily, however, if a motor runs backward, it may be assumed that the connections are wrong. Usually changing the connections to the brush holders, so that the brushes change their signs without changing any other connections, will make the motor change its direction of rotation. A series motor also may be made to change its direction by changing the direction of current flow in either field coils or armature, but not in both.

On starting up, a self-exciting dynamo is supposed to build up its voltage to normal, having at first no excitation save that of residual magnetism. After standing some time, or in proximity to other dynamos, or after being hammered, the magnet frame may have lost all its residual magnetism. In this case the machine does not build up when revolved. By passing a current from another machine through the field coils the dynamo will generate as a separately excited one. Then the exciting current may be thrown off and the self-excitation thrown on, when the machine will build up satisfactorily.

If the residual magnetism becomes changed in direction, or the separately exciting current be passed in the wrong direction, then what little voltage may be generated will, when connected for self-excitation, send the current in such direction as to tend to demagnetize the field, and building up will be impossible. A shunt machine builds up better the less the outside load, since at no load the terminal voltage is the greatest and the most likely to send a magnetizing current in the field coils. A series machine builds up better when the outside load is increased. Such a machine may even be momentarily short circuited to make it build up. For a given voltage resulting from residual magnetism, the current in the field coils is greater the less the resistance in the circuit. If the connections to one of the field coils in a bipolar machine be reversed, causing two poles of the same polarity, the machine will of course fail to generate. This condition may be detected by the use of a compass needle. Small machines sometimes generate starting a few volts, showing proper connections and the presence of some residual magnetism, but refuse to build up beyond this point. It is sometimes convenient to materially increase the speed of such a machine, whereupon it will build up rapidly, and the speed may then be reduced to normal, and the dynamo will continue to generate at its normal pressure.

Lap and Lead

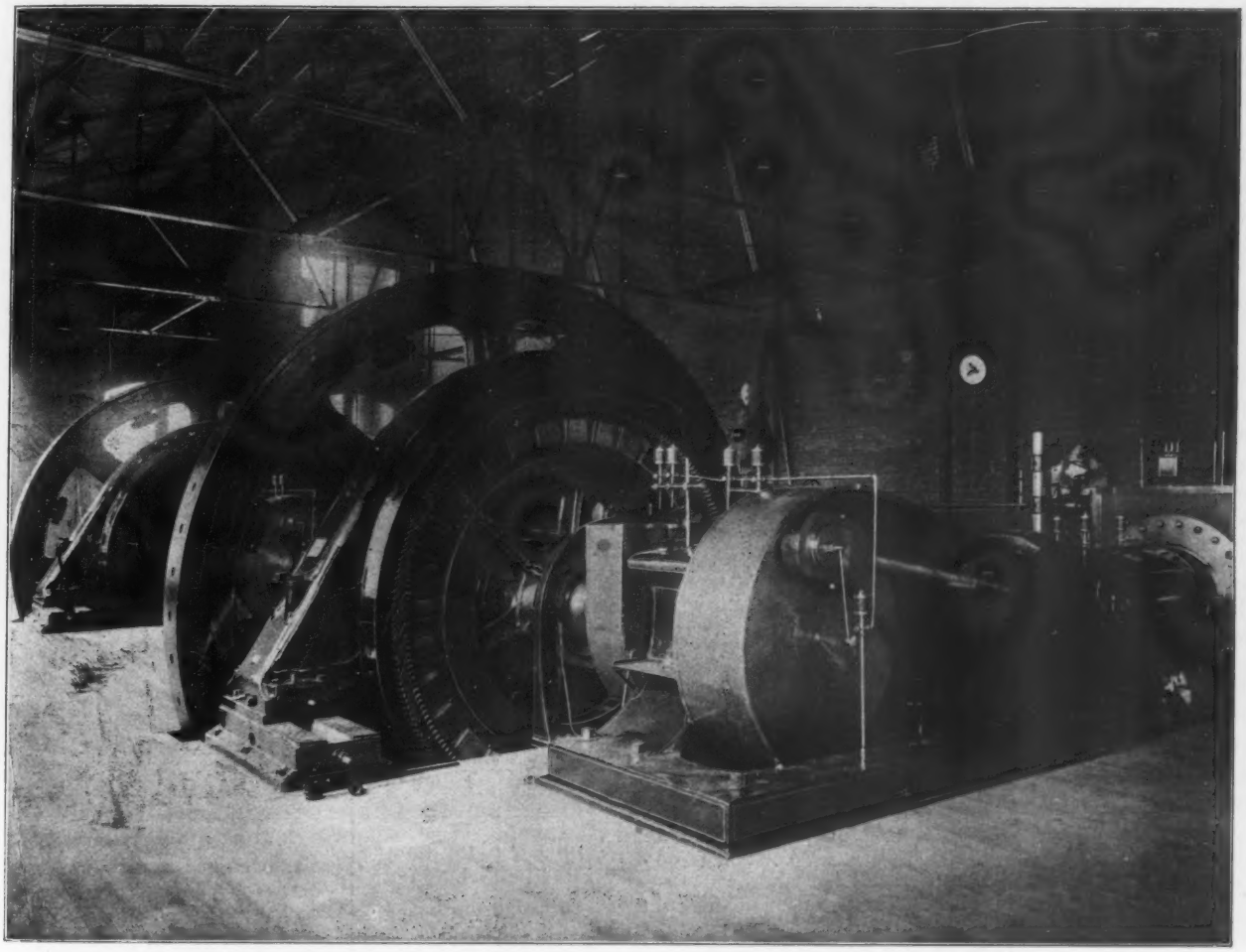
For the information of those who may not clearly understand the meaning of the words, lap and lead, I will say lead means the amount of opening that the valve gives when the engine is on center, and that by lap is meant that portion of the valve which extends beyond the ports when the valve is placed on the center of the travel, and that the object of adding lap is to cause the valve to cut off the steam before completion of the stroke and thus save fuel. By inside lap is meant that portion of the valve which projects over the ports on the inside, or towards the middle of the valve, and the object of it is to give the engine compression.—*Exchange.*

The Cincinnati, Georgetown & Portsmouth Railroad Changed from Steam to Electric Traction

The Cincinnati, Georgetown and Portsmouth Railroad Company was organized in 1872 and was chartered to build a railroad (commonly called Steam Railroad) from Cincinnati, Ohio, Hamilton County, through Clermont, Brown, Adams and Scioto Counties to Portsmouth, Ohio. The road was equipped and built as a narrow gauge railroad. On October 1st, 1901, the road was purchased by A. W. Comstock, of Detroit, Mich., and W. R. Todd & Company, of Cincinnati, Ohio, the present owners of the road.

miles of road, all of which except five miles were until lately laid to a three-foot gauge with 40-lb. iron and 60-lb. steel rails. At present, new 70-lb. steel rail has been laid over about one-half of the road, the other half having been laid recently with 60-lb. steel rail. New standard ties throughout the entire length of the road have been put in, and washed gravel of a very excellent quality is being used to ballast the road, so that when finished the road-bed will be of the highest order.

This road traverses high table land and owing to the difficulty in reaching this table land through heavy cuts and deep fills, there were, up to the time the change was contemplated, 37 wood and steel trestles on this road. Nearly all of these



Two 600-Kilowatt, A. C., Engine-type Generators, Highland Park Power House of the Cincinnati, Georgetown and Portsmouth Electric Railway.

Plans were immediately made for changing from narrow gauge to standard gauge and equipping the road with electricity instead of steam.

During the past year this change of equipment has been going on and several extensions have been added to the original road, namely—from the main line at the New Cincinnati Water Works a branch has been built to Coney Island, which is one of Cincinnati's famous resorts, and from the power house, which is located at Olive Branch, about fifteen miles from Cincinnati, another branch line has been constructed to Batavia, Ohio, the county-seat of Clermont County, connecting the main line with the Norfolk & Western Railway. Its lines now comprise 50

wooden structures have been filled up with earth and the balance have been strengthened so as to permit heavy standard locomotives, passenger and freight cars to pass over them. Nearly four hundred thousand cubic yards of material have been used in making these fills.

The territory through which this road runs is largely agricultural and is of a high order. Thousands of acres of this country produce great quantities of fine fruit of all kinds, berries, tomatoes, tobacco, grains, cattle, hogs, etc. There are numerous canning factories along the railroad which do enormous business. The county is fairly thickly settled, the farms being for the most part small.

It is estimated that with the increased facilities, which the electrical service will give, the passenger business ought to be trebled. There will be no clouds of dust arise from heavy travel along the turnpikes. The possibilities for high speed are great, and it is expected that an average speed of about forty miles an hour will be maintained with the utmost safety to operation. The scenery is picturesque, and traversing a private right of way as it does, the frequent stops which always occur on the highway will be obviated.

At Olive Branch, where the power house is located, there has been constructed a lake which covers ten or twelve acres of ground. The company owns about fifty acres of ground here and this will be laid out and made a pleasure park. It is proposed, and already a company has been negotiating to construct a large summer hotel at this place. The elevation at this point is about one thousand feet above sea level or about five hundred feet above the level at Cincinnati.

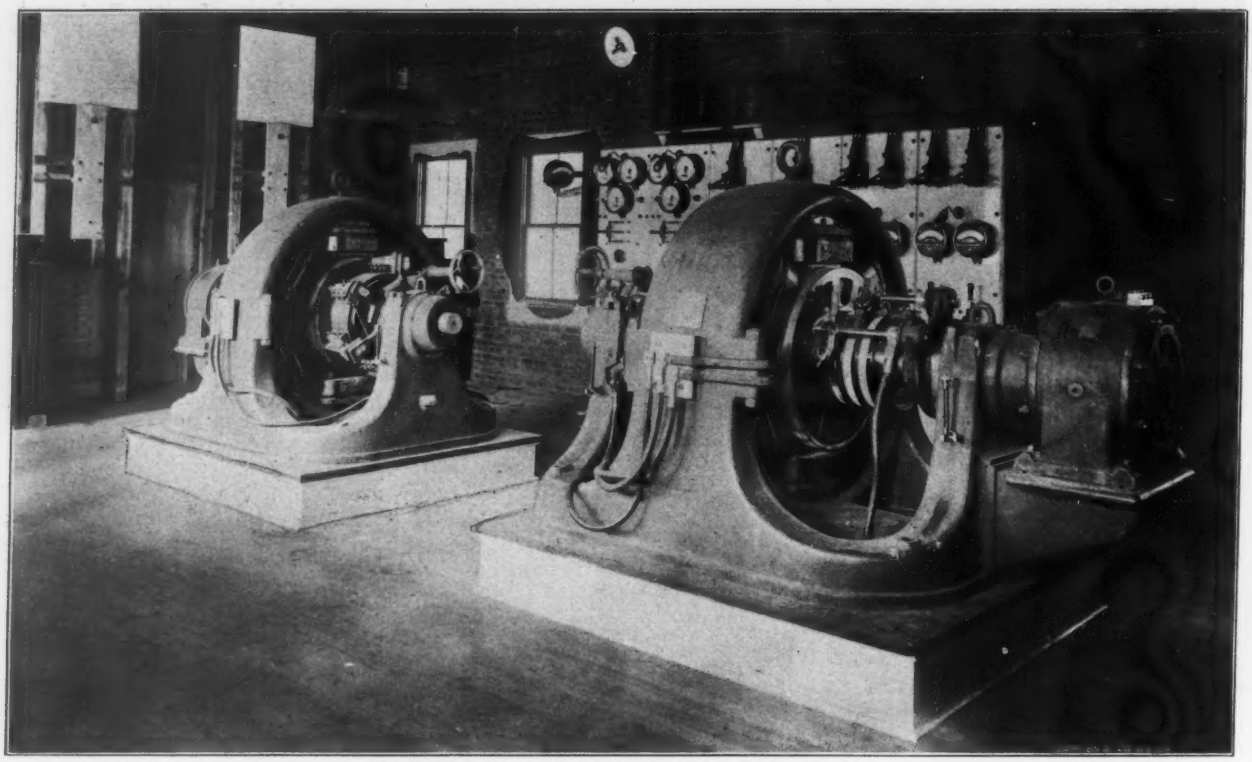
The electrical equipment now consists of the most modern that is known at the present time, the power house at Olive Branch is built of brick and concrete and is modern and up-to-date throughout, and is said by experts to be one of the finest of its kind in this part of the country.

The Power House building, including boiler and engine rooms, measures 151′ 10 x 95′ 10 . The engine room measures 151′ 10 x 45′ 6 and the boiler room is of similar length, measuring from center to center of walls 48′ 6 . The building is of brick with steel roof trusses, slate roofing on two inch tongued and grooved sheeting. The boiler-house is arranged for four batteries of boilers of 500 H. P. each; there being two 250 H. P. boilers in each battery. The boilers are "Cahall" Babcock and Wilcox water tube boilers; there being a smoke stack for each battery of boilers. There are at present installed three of these batteries with a total horse-power of 1500. The foundation for an additional battery is constructed ready for its installation, if required, at some future date.

In the boiler room are two Worthington boiler feed-pumps, each of sufficient capacity for feeding 2000 H. P. of boilers. There is also one 2000 H. P. Stillwell and Bierce open-type heater; together with all piping and fittings required. Coal storage is arranged alongside of the boiler room so that cars can be run on trestle track and the coal dumped into bin.

There are foundations for three cross compound, engines constructed; together with foundations for exciter engine, rotary converters and switchboard.

There is a space at one end of the engine room, measuring 14′ x 45′ partitioned off by brick wall for transformer room. In the opposite end of engine room is pump pit, measuring 22′ x 45′; the floor of this pit being some 14′ below the level of engine room floor.



Two 150-Kilowatt Rotary Converters, Highland Park Power House.

There are at present installed two cross compound condensing Hamilton Corliss engines. The dimensions of these engines are high pressure 24 in diameter, low pressure cylinders 44 in diameter and having 42 in stroke and designed to operate at a speed of 90 revolutions. Connected to these engines are two direct connected Westinghouse 600-K. W., 3000 alternations, 360 volt, three-phase, alternating current generators. There is also in the power house one Harrisburg exciter engine, directly connected to 50 K. W., Westinghouse generator; also one Westinghouse motor driven exciter set, consisting of one 75 H. P., 360 volt, three-phase motor, directly connected to one 50 K. W., 110 volt generator. There are also in the power house two 250 K. W., 25 cycles, 360 volt, A. C., 600 volt D. C., rotary conver-

ters; together with marble switchboard complete, for control of generators, rotary converters and having switchboard panels for the control of long distance transmission circuits. There are in transformer room six 200 K. W., 360—15000 volt step up transformers; together with circuit breakers, lightning arresters for long distance transmission.

The condensing apparatus consists of one central condenser of sufficient capacity for the operation of the three units for which the station is equipped.

The water supply was obtained by building a dam across a natural ravine, through which flowed a small stream. The width of the lake thus formed will average about 300 ft. x 3000 ft, long, with an average depth of 16 feet, this lake giving ample and permanent water supply of pure water

There is in addition to the converting apparatus in the main power house three sub-stations, located one each at Mt. Washington, Bethel and Sunshine; these sub-stations being located so as to feed current to the line a distance of five miles each way. These sub-stations are also designed to answer as freight and passenger stations. The sub-station at Mt. Washington is a brick building, measuring 72 ft. x 30 ft,; the freight room measuring 13 ft. of the length and the waiting room measuring 13 ft. of the length; the middle portion of the building being divided for the installation of the electrical apparatus.

The electrical apparatus installed in this sub-station is as follows, viz:—

Two 250 K. W., 360 A. C., 600 volt, D. C., 25 cycle Westinghouse rotary converters, and three 200 K. W., 360-15000 volt step-down transformers; together with switchboard having alternating and direct current panels, lightning arresters, choke coils, circuit breakers, etc., complete.

The sub-station at Bethel is of similar design, excepting that the waiting room and freight room are larger; the freight room being 19 ft. wide and the waiting room 17 ft. wide, and the overall dimensions being 81′ 4 ft. The general design of this sub-station is architecturally superior to the sub-station at Mt. Washington; there being at one end a covered platform 25 ft. wide to serve as a waiting space in the summer time. The electrical equipment of this sub-station consists of two 150 K. W., rotary converters and three 100 K. W., 330-15000 volt step-down transformers; together with switchboard and auxiliary apparatus.

The sub-station at Sunshine is similar to the sub-station at Mt. Washington excepting that waiting room is omitted and electrical apparatus installed in Sunshine sub-station is similar to the apparatus installed at Bethel.

The line construction is span wire; there being 2,000 trolley wires, supported by span wire from poles measuring 30 ft, on one side and 36 ft. on opposite side of track.

The long distance transmission lines are supported on cross-arms on 35 ft. poles. The construction of the trolley line and the high potential transmission line is of the most sub-stantial character: care being taken by the use of special cross-arms and special extra heavy pins and insulators to guard against stoppage of operation through mechanical failure of the transmission lines.

Provision has also been made in the construction of the transmission line eastwardly from the power house for the installation of an additional three-phase circuit to be used in event of the extension of the line eastwardly.

The trolley car equipment consists of 10 passenger cars, having 40 ft. bodies with a length of 50 ft. overall and a width of 8 ft. 10; and three combination cars of the same type and make; six open passenger cars 40 ft. overall; width 8 f 4 ft; six closed passenger cars, 40 ft. overall, width 8 ft. 4 .

These cars are mounted upon trucks of the Pullman type, built by the St. Louis Car Company. These cars are built in the strongest manner possible and finished in the best manner. The Equipment consists of four No. 56 Westinghouse motors with type K 14 controllers.

There is also in process of construction three express and mail cars to be mounted on trucks of similar type to the passenger coaches and to be equipped with similar electrical equipment.

The Noon Hour at Power's Mill

NUMBER II. BY A. EDWARD RHODES.

Never was I more surprised than when Charlie refused to let me photograph him for the PRACTICAL ENGINEER We always thought he was stuck on himself, and I thought he would feel complimented to see his picture in the steam engineers paper. But, no; instead of that he is so modest that he said it would detract from the diginty of the steam engineering profession if the people who read these noon hour talks would recognize him as the intelligent kid that he says I make him. So, unknown to him, I drew his picture yesterday noon as he was deeply interested in upholding his end of an argument with old Dick.

Last month, I neglected to say, that at noon time Charlie always washes up and puts on a collar and tie, says he feels more comfortable and enjoys his dinner atll the more for it, and often, when we say something about the dude, he advises us to go to and do likewise and we will feel better for it. I am inclined to think he is right, and if ever I can screw up enough courage I will take to wearing a collar to and from work. One thing I have noticed is that now there is not a member of Power's Engineering force, from ash wheeler to old Dick himself, but what at least washes his hands AND FACE at the noon hour,—a much different condition of things than used to be. And then his chair—any old box or board is good enough for us,—but the first week of the kid's advent among us found a brand new cane seated chair in the engine room. He has stuck to that chair in spite all that we can say or do, and woe to the man or boy that dares to lay a hand, loving or otherwise, upon it. Although many a time have I seen him give it to one of us older men to sit on at noon after what Charlie knew to have been an unusually hard morning, old Dick says he believes the tarnal kid brought it more for us old men than for himself.

What I wanted more particularly to tell you about was our discussion last Tuesday noon hour. Tom, the fireman over at Heaten's, wanted to know if the pressure of the atmosphere on the top of a lever safety valve made any difference in the correct pressure in a boiler. After much argument pro and con, the kid said, "My idea about it is this—the pressure of the atmosphere in round numbers, is 15 pounds per square inch. This pressure tends to hold the safety valve down to its seat. When the pressure in the boiler is 15 pounds (from vacum),

then the pressure outside and inside the boiler is balanced; there is neither bursting or collapsing pressure on the boiler shell; hence, a safety valve or an ordinary steam gauge shows what it is desirable to know, *viz.*, the pressure that is operative to disrupt the boiler. The only trouble Tom had in the matter was in supposing that there is not pressure in the boiler until it shows on an ordinary steam gauge, and this has puzzled many a young and some old engineers. As a matter of fact, I remember reading that light-loaded condensing engines could be run when the steam gauge shows no pressure whatever, and you might be interested to know that one day, about a year ago, that time Dick was to Reading attending the A. O. of S. E. meeting, I started up the little horizontal and run her unloaded for about five minutes with the gauge needle tight up against the stop pin. My explanation of the fact that the engine turns over when the gauge shows no pressure is that, because the condenser and air pump removes the greater part of the back pressure, *i. e.*, the pressure of the atmosphere. In all calculations pertaining to steam, pressures are reckoned from vacuum; reckoning them from the atmosphere is only a matter of cancellation, and is unfortuate in that it confuses many of us who ought to know better, but who have gone astray from the influence of popular rather than scientific or sensible considerations."

Say, Dick, what's the matter now? Anyone can see you are off about something. Humph, so would you be; you know that ever since that new machine has been hitched onto that 12 x18 engine, Mr. P. says she needs a new eccentric with a larger throw and a new slide valve. I'd like to know how that is agoin' to make her any better; she now cuts off at ¾ stroke and eats up more'n her share of steam. Maybe her ports aint large enough, an' mabe they are; if they aint wide enough then makin' the valve travel more weight make her do better, bu I tell you I never yet see the engine owner that knows more'n the builder of her, providin' he knows his business, an' most of em do. But I says to Mr. P. that when a engine has to carry a overload it's time to throw her out, or else if she is in good shape and other conditions will allow of it, she can be speeded up by a slight change of her governor. That will give more power, but I don't believe Mr. P. knows whether the steam ports are not opened enough or not. He says the valve gear ain't correctly designed. I was a'talking to Jim about it and he says to hitch her over to the new b'iler that carries 160 pounds. Gee, its time to start up.

I might add that the engine is now connected to a battery of boilers carrying 80 pounds of steam and further from the engine than the new boiler mentioned. That the engine would meet the demands made upon it by the new machine, if she were connected to the new boiler, I have no doubt, and I also believe that after the change was made she could be made to cut off earlier and show a decided saving of steam. But neither Mr. Powers or Dick wants to make the change—Dick from pure contrariness, and Mr. Powers for the simple reason that he somehow got it into his head that the valve gear is not properly designed.

Some Electrical Fire Hazards

DEVEREUP.

The third cause is that in which an inflammable material is permitted to come into contact with parts of a circuit that have become heated. This cause may be divided into two classes: that in which insulation is the material, and that in which a material exists, but adds nothing to the benefit of the circuit. It is obvious that there is no necessity for these distinctions, for the result is ultimately the same and will be treated as such.

In the manufacture and distribution of electrical energy there is a loss by heating due to the fact that all substances have a resistance which has to be overcome and which represents a loss in energy, which is substantially all transformed into heat. The heat which is produced in a wire only depends on the number of watts expended electrically by the current in overcoming the resistance of the wire, which resistance varies with different materials, and goes to raising the temperature of the conductor and indirectly that of the surrounding bodies; and this rise continues until the rate at which heat is lost equals that at which it is generated; then the temperature becomes constant. It is obvious, therefore, that an electrical conductor is only capable of carrying a certain current with a given elevation of temperature, and, practically, the allowable temperature is limited by consideration of injury to insulation and the danger of fire.

The temperature elevation of a wire for a given current strength depends upon its resistance, diameter, covering, and its surroundings. A copper wire carefully insulated by a thin coating of water-proof material and placed in still water usually kept comparatively cool, owing to the rapid conduction of heat through the insulated cover into the water.

The same wire, carrying the same current, but suspended in air instead of being immersed in water, will usually attain a considerably higher temperature, as still air does not carry away heat from the surface of the wire so effectively as still water. For the same reason a wire buried in the ground will, in almost all cases, be found to be cooler than where supported in the air. A covering of, say, cotton, rubber, or other electrical non-conductor will, up to a certain thickness, serve to cool the wire by increasing its surface.

The same heating conditions would apply to switches, switch or fuse lugs, bus-bars, commutators, and in fact to any current-carrying parts of a circuit, and it is therefore necessary that they be sufficiently heavy to carry the required current without undue heating.

Heating may be the result of insufficient contact surface, and the tendency in all cases is to increase the temperature to a dangerous point, or to melt and ignite the insulation of an inflammable nature, such as rubber and cotton. It is necessary, therefore, that the carrying capacity of current-carrying-parts and of contacts shall be limited.

Poor connections at fuse blocks may produce heat enough to cause the fuses to melt when there is really no trouble elsewhere on the circuit. This may occur when the fuse blocks have too little contact surface at the connection points to properly carry the current, or when the contact surface is not secure, in which case arcing occurs, pitting the surfaces and intensifying poor contact.

The formation of an arc may be understood by the following explanation: The two conducting terminals under ordinary circumstances are brought together before being separated to establish the arc. As soon as this separation commences, the spark which tends to form at any break in a closed circuit vaporizes a portion of the materials of the electrodes, thus establishing a bridge of conducting vapor through which the current flow is maintained. The concentration of energy in a

small space produces an intense heat, which vaporizes the electrodes more rapidly. The temperature of this arc, although difficult to determine accurately, is about 3500° C. We may obtain an approximate idea of this heat when we consider that about 500° C. are necessary to make solid bodies glow with light, and that the melting-point of platinum is 1775°C.

As was noted previously, the presence of two leaks on an electrical circuit, creating an electrolytic action and finally a break in a circuit, is attended with the destructive arc. It is equally true that the breaking of any circuit, whether it be by means of a properly proportioned switch, the melting of a fuse or the breaking of a current-carrying wire, is attended with this arc. Where the numerous blowings of fuses have occurred. the porcelain surface of the fuse block is often covered with a layer of metallic substance, which becomes a partial conductor. Upon the repetition of this blowing, an arc is formed and maintained by this metallic layer; in many cases the porcelain cover is fused and broken.

In other cases—particularly slate switch and distribution boards, the melting and resulting arcing have been known to crack the insulating substance and the various conductors short-circuited. In other cases the short-circuiting of an incandescent lamp has destroyed the sockets or controlling devices beyond repair. The throwing out of sparks from arc lamps and the dropping of hot carbons have been known to cause fire. Sparks from the commutator of motors, from the short-circuiting of flexible cords and of fixture wires, from the short-circuiting of cables in conduits and in manholes, igniting accumulated gases; from short-circuits in sockets, attachment plugs, receptacles, switches, and various other devices have been known to cause fire.

Overheating of wires, of motors, dynamos, and switchboards from overloads; overheating of starting boxes; overheating of theater dimmers and regulating boxes from overload; overheating of improperly made joints, which may be considered the weakest part of an installation, and may include joints between wires, between wries and lugs, between lugs and busbars, or between switch blades and clips; overheating of magnet coils or resistances of arc lamps, and innumerable other similar defects have been known to create a fire.

Other sources of fire may be the contact of an incandescent lamp with inflammable material, such as cotton, paper, wool celluloid goods, etc.; the melting of fuses, the breaking down of insulation, sparking from electrolysis, or short-circuits in places impregnated with inflammable gases, such as benzine, naphtha, ether, hydrogen, gasolene, and many others of explosive nature; also in any class of manufacture where vegetable material is distributed through the atmosphere in the form of dust, extra precautions are absolutely necessary, the least flash or arc being sufficient to cause an explosion. While the electric light is the safest light in places of this character, the wires should be placed in iron conduit, there should be a vapor-proof globe over the lamp, and cut-out and switch should be located at a safe distance.

Candy factories, sugar refineries, flour mills, breweries, saw mills, and others of like hazardous nature may be considered in this category; also textile mills, where there is an accumulation of the particles of stock that is carded out, which particles, owing to their extreme lightness, fill the air in the room and settling, completely cover everything with an inflammable material usually known as "fly," which is a fine dust of vegetable matter. In this condition the dust may be ignitrd hy the blowing of a fuse or similar accident.

It has been contended that electric light stations burn more rapidly than buildings of the same construction, but used for other purposes, and it has been supposed by some that this is due to the saturation of the walls, floors, and its entire structure with electricity. The atmosphere in central stations supplying light or power is impregnated with ozone, the result of electrostatic discharge from belts and sparking brushes, and intensified by the more favorable conditions of heat and dryness necessary to the proper operation of a station. That ozone adds to the heat and rapidity of a fire once started is evident and is a subject for further investigation.

It is quite apparent that the same state may be created in manufacturing establishments where favorable conditions exist.

Static electricity has been justly considered as a cause of fire. Combustible gases and vegetable dust may become ignited by the spark resulting from the static discharge from belts.

Electrical excitement manifested by sparks and chocks is so common in manufacturing institutions as to cause no comment. In explosions that have occurred in breweries, dying establishments, oilcloth works, printing offices, chemical works, distilleries, flour mills, and manufactories of similar character, the cause has been traced to electric sparking or the friction from static electricity.

It will be noted from the remarks made in this paper that electricity is treated as a source of heat and as such is classed as a fire hazard, and it is fair to say that it presents to us a most dangerous and powerful factor in that respect if permitted to be neglected.

That the situation is not worse is due primarily to the fire under-writers, who early realized the importance of restricting indiscriminate methods of construction, in order that the greatest possible immunity from fires may be secured.

With these facts in mind the National Electric Code was compiled and published by the American Institute of Architects, American Institute of Electric Engineers, American Society of Mechanical Engineers, American Street Railway Association, Factory Mutual Fire Insurance Companies, National Association of Fire Engineers, National Board of Fire Underwriters, National Electric Light Association and the Underwriter's National Electric Association, a compilation most worthy of the honorable and learned bodies referred to. It provides for almost all emergencies, yet circumstances may and do arise where, from a possible misinterpretation or the unusual conditions present, the code does not seem to apply.

In applying the code it is very evident that care must be taken in the proper discrimination of the hazard and to apply that electrical system which will be less apt to enhance the hazard.

A system which would be comparatively safe to introduce in a department store would fail and break down in breweries, dyehouses, bath-houses, and places of similar character, due to dampness; and in chemical works, starch and sugar works, textile mills, paper mills, gunpowder works, fur tanneries, coal mines, and flour mills, due to danger of ignition or explosion of the dust by electrical sparking.

Extra precautions should be taken in regard to the use of rubber-covered wire in warm rooms, such as engine and boiler rooms, hot rooms in bath-houses, and in drying-rooms. The same precaution should be taken in regard to the use of any

wire, other than rubber-covered, in damp places. Thus, it wil be seen that, as conditions vary, one quality of insulation would be advisable in one location and would be absolutely unsatisfactory in another location.

Generators, motors, switchboards, resistance boxes, and equalizers would be unsafely placed if located in damp rooms. Transformers would be dangerously placed if inside buildings where the oil or smoke from the burning out of the coils or the boiling over of the oil could do harm.

It may be correctly judged that, in the installing of electric wiring supplying incandescent or arc lamps, motors, heaters, or other apparatus, extreme care must be taken to avoid, wherever possible, gas-pipes, water-pipes, the space under the bathrooms and water tanks, and general metallic construction, including metal awnings, metal ceilings, iron beams, cornices, awning frames, and signs.

The introducing of various auxiliary devices for varying the candlepower of lamps, lamps in series with bell and telephone systems, and connected to lighting system and other similar makeshifts, are in the wrong direction, increasing the fire hazard, not necessarily because of faulty constructions, but because their constant manipulation is in the hands of those less informed or absolutely ignorant of the danger involved. The dangers of poor joints have been discussed, and I can but suggest a remedy, and that is, The only precaution against poor joints lies in the prevention of them.

The secret of long-distance transmission lies in the successful employment of very high voltages, and, regardless of the character of the current employed, the difficulites of insulation confront us. It is important that the line as a whole must be insulated against direct earth connection or short-circuit in underground service, and grounds or short-circuits if the line is an ærial one.

The quality of insulators is another important consideration, owing to surface leakage or puncture. Surface leakage is more to be feared, as it can never be depended upon, being a function of moisture from rain, wet snow, or fog, and drifting dust, which is difficult, if not impossible, to provide against, and which varies with the location.

High-potential circuits are also objectionable in any location where telephone, telegraph, signal systems, and similar circuits are in proximity to them.

Extra attention must be given to an installation supplied by secondary alternating currents, in order to reduce the hazard and provide for any defects that may result from the breaking down of insulation of primary wires.

Overhead wires should be protected by lightning arresters, the proper distribution of which depends on local conditions.

The more frequent and intense the storms may be in any location, the more lightning arresters should be used. It is important that thoroughly good earth connections shall be obtained and that the wire shall not be subject to mechanical injury.

In order that lightning arresters shall be most effecive, the wires leading to the earth should be as straight as possible, avoiding kinks or sharp bends. The best prevention of trouble from dead overhead wires, and the danger from their crossing with telephone, telegraph, or call systems, electric light and power wires, would be their removal.

Trolley system should be protected by guard wires the entire length of the trolley circuit.

The construction of temporary work for display decorations or general lighting, regardless of the length of time it may be used, should be the same as permanent work. Invariably this kind of construction is rushed in a haphazard way, and, combined with the usual attending flimsy and inflammable decorations, presents a condition not desirable—many times quite dangerous.

The great problem is how to secure safety, and this may be answered: By the proper methods of construction, using only high-grade material.

Evidences of the lack of knowledge on electrical subjects are quite apparent: nails and screws driven into electric light molding, wires in contact with foreign metallic objects, fuses uncovered so that molten metal may fly about among inflammable material, and conductors so overloaded as to be perceptibly hot.

The fire hazard should be always carefully considered in an electrical installation. A system of electric wiring may be ideal from an engineering point of view, and yet as a fire hazard would be most dangerous.

While the operation of electrical apparatus is burdened with many dangers under some conditions, the reverse may be said when the equipment is installedd by skilled wiremen guided by experienced engineers and the National Electric Code carefully applied; and it is essential, when alterations or repairs are necessary, that, as a continual safeguard, due notifications be given to the local Board of Fire Underwriters. Under these conditions electricity is as safe as any source of power and the safest source of light known to mankind.

Steam Turbines

A recent computation has placed the total aggregate power of steam turbines in use or under construction or ordered in different parts of the world at over 500,000 H. P.

Of this total the major portion is used or to be used for the driving of dynamos, alternators, or other electrical machinery, while the next in point of power consumption is marine engines.

An item in point is the contract recently given to the British Westinghouse Electric & Mfg. Co., Ltd., by the Metropolitan District Railway Co., of London, England, for four turbo-alternators. Each of these machines is designed for a normal capacity of 5,500 kilowatts, but will be capable of carrying an overload of 50 per cent., giving for each unit a maximum output of 8,250 kilowatts, or about 11,000 E. H. P.

These turbines will be not only the largest steam-turbines ever made, but also the most powerful single cylinder engines of any type whatever in the world. Very few multiple cylinder engines existent have greater power.

Notwithstanding the truly enormous power they will develop, the dimensions of these engines are only 29 feet in length, by 14 feet wide, by 12 feet high, the over-all length of turbine and alternator being 51 feet 9 inches. The steam pressure will be 165 pounds per square inch, and the speed 1000 R. P. M.

The Ratio of Expansion

By R. T. Strohm.

In the ordinary non-condensing steam engine, the steam is exhausted from the cylinder at a pressure several pounds above that of the atmosphere. As a consequence, the full expansive force of the steam is not made use of. In other words, the

steam in the cylinder at the point of release still possesses the property of expansibility, and hence is capable of doing further work.

Take the indicator card shown by full lines in Fig. 1. Release takes place at the point *c*, and the work done by the steam is represented by the area *abcd*. The steam expands from *b* to *a*. Now, if the steam were not released at *c*, but instead allowed to continue its expansion to *f*, the worv area of the diagram would be increased by an area *cdf*, and the total work would be represented by the area *abfe*.

There are two reasons, however, which prevent such procedure; or, perhaps, to be more exact, it would be better to say that there are two reasons why such a course would not be economical. In the first place, it would be necessary to increase the length of the cylinder to a considerable extent. This would mean a greater length of stroke, a longer crank, and a longer engine bed, and consequently a much increased first cost of the engine. The gain in work by the addition of the area *cdf* would not be nearly proportional to the increased cost of the engine. In the second place, increasing the length of the cylinder increases the amount of cylinder surface in direct proportion. And since in the ordinary engine the loss by condensation is large, this increase in the heat radiating surface would tend to add greatly to the loss by condensation. These two considerations, then, make it imperative that the steam be released at a pressure considerably above that of the atmosphere in non-condensing engines.

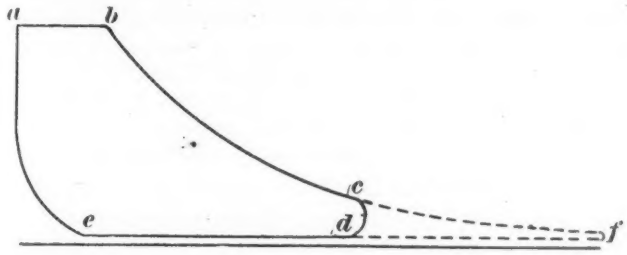


Fig. 1

In order that the piston may move at all, the pressure per square inch tending to urge it forward must be greater than that per square inch tending to retard it. A glance at the expansion curve *bf* will show that after the point *c* is reached the curve falls very slowly, while the pressure is very little above atmospheric pressure. This means that near the end of the stroke the total pressure on the piston is small, and consequently the area *cdf* represents very little work. However, the main point is that the nearer the steam is expanded down to the pressure of the atmosphere, the more nearly do we obtain the greatest possible amount of work from a non-condensing engine.

There are ways, nevertheless, in which to increase the amount of work which a given volume of steam at a stated pressure will produce. One of these is to lower the pressure against which the engine must exhaust, by removing a portion of the atmospheric pressure. This is accomplished by adding a condenser.

The effect obtained by the use of a condenser may be illustrated by Fig. 2. The diagram in solid outline represents the indicator card as taken without the condenser being attached to the engine. Its area then represents the work done. Now, suppose the condenser to be put into operation, and the point of cut-off shifted until the resulting diagram, as shown by the dotted outline, represents the same area as the solid outline. Since the areas are equal, and the scales are the same, it is evident that the work in both cases is the same. Yet, when run non-condensing, the engine uses a volume of steam per stroke represented approximately by the distance *ca*, which is the volume of steam in the cylinder and clearance spaces at the moment cut-off takes place. After the condenser is attached, the cut-off is shortened. The volume of the steam in the cylinder, including clearance, at the point of cut-off, is then represented by *cb*. In this particular instance, $cb\text{-}\frac{1}{4}ca$. Consequently, by the addition of the condenser in the case cited, a saving of $\frac{1}{4}$ the steam, roughly speaking, was effected, without any decrease in the amount of work done.

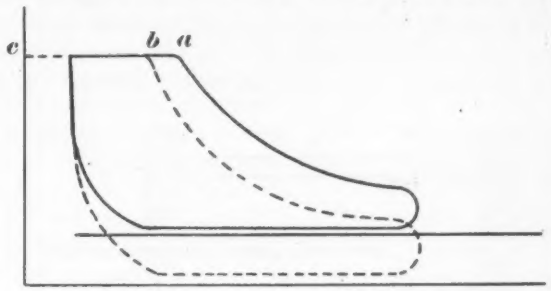


Fig. 2

Still another method of attaining the same result is to increase the pressure of the steam used, at the same time making the cut-off earlier. This may be clearly seen by reference to Fig. 3. By raising the pressure from *oa* to *ob*, and by reducing the volume of steam used per stroke from *fd* to *fc*, the work area has been increased by an amount equal to the area *abhk*. It is true that steam at a higher temperature contains a larger amount of heat per pound, and it is natural, therefore, that the work per unit of weight should be greater. But a glance at the steam table will show that the pressure of steam changes much more rapidly than the corresponding total heat. In other words, the work obtained by the additional area *abhk* is greater than the mechanical equivalent of the heat difference between the total heats at the pressures *ob* and *oa*.

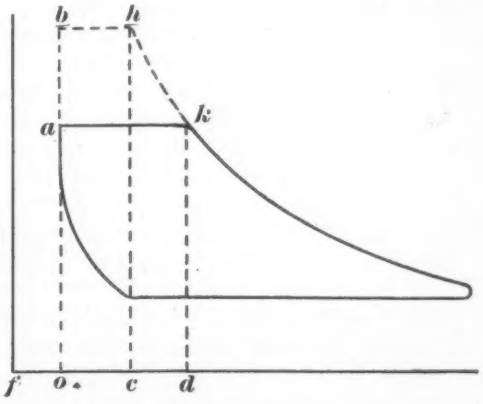


Fig. 3

From what has been stated it will be seen that the economy of the steam engine is dependent upon the degree to which the steam is expanded, and that the greater the expansion, the greater the amount of work per unit of steam used. To ex-

press this in other words, the greater the number of expansions, the better the economy.

The ratio of expansions, or the number of expansions, is the number of times the final volume, at the end of the expansion, is greater than the original volume. Suppose the cylinder shown in Fig. 4 to be 4 feet long, exclusive of piston thickness, and the piston 2 square feet in area. The volume of the cylinder is then 8 cubic feet. Let the piston be one foot from the head end, and the intervening space filled with gas. This volume is then 2 cubic feet. Now let the piston be moved toward the right to the end of its stroke, the gas will now

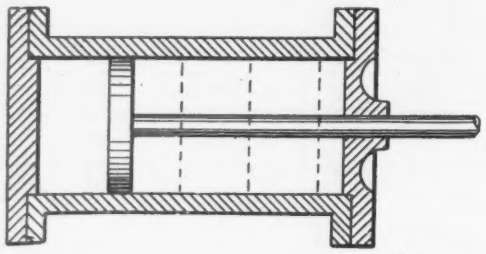


Fig. 4

fill the entire space between the piston and the head end. That is, it will occupy a volume of 8 cubic feet. It has expanded from 2 to 8 cubic feet, and the final volume is 8-2=4 times the original volume. Therefore the number of expansions, or the ratio of expansion, as it is otherwise called, is 4.

In the ordinary steam engine, however, there is another factor which must be taken into account in determining the ratio of expansion. This is the clearance volume. For when the piston is at the point of cut-off, the volume of steam which does the expanding is not only the volume swept through by the piston up to the point of cut-off, but also the volume of the clearance. And at the end of the stroke, the volume of the steam is the entire volume of the piston displacement plus the clearance volume. Hence, in the simple engine, the ratio of expansion is the ratio of the volume at the end of the stroke, including clearance, to the volume at the point of cut-off, including clearance.

As previously stated, it is not feasible to increase the pressure and shorten the cut-off to any great extent in a single cylinder, for the reason that the range of temperature is thereby increased and consequently the loss due to cylinder condensation. To avoid this, the compound and multiple expansion engines have come into being. These allow the use of high initial temperatures, and of course a wide range of pressures, and yet obviate, in a great measure, the condensation loss. The reason for this is that the range of fluctuation of temperature in each cylinder is considerably reduced, since the steam expands successively in two or more cylinders.

In the compound engine, the ratio of expansion is found, as before, by dividing the final volume by the initial volume. The final volume is the volume which is exhausted into the atmosphere or the condenser, and the initial volume is the volume of the high-pressure cylinder up to the point of cut-off including clearance. Hence, to find the ratio of expansion of a compound engine, multiply the number of expansions in the high-pressure cylinder by the ratio between the volumes of the low-pressure and high-pressure cylinders.

Suppose that the real cut-off in the high-pressure cylinder of a compound engine is $\frac{1}{4}$, and let the low-pressure cylinder have a volume four times as great as that of the high-pressure cylinder, The number of expansions which take place in the high-pressure cylinder is 4, or the reciprocal of the real cut-off. The ratio of the cylinder volumes is 4. Then the ratio of expansion, or total number of expansions, is 4x4x16.

It will be noticed that this rule takes absolutely no notice of the point of cut-off in the low-pressure cylinder, since the latter can have not effect upon the ratio of expansion, the point of cut-off in the high-pressure cylinder being fixed. For at each stroke, the volume of the steam admitted to the high-pressure cylinder is $\frac{1}{4}$ the volume of that cylinder, so that there is discharged from that cylinder at each stroke a volume four times as great as the original volume admitted. Now, this exhaust must pass into the low-pressure cylinder and expand there. It can escape only by going through the low-pressure cylinder. Furthermore, the volume of the low-pressure cylinder is constant, and there is discharged from the low-pressure cylinder at each stroke a volume of steam equal to four times the volume of the high-pressure cylinder. Hence each volume of steam from the high-pressure cylinder is expanded four times in the low-pressure cylinder, making 16 expansions in all. The ratio of expansion may then be expressed in another way. It is equal to the product of the number of expansions in the high-pressure cylinder and the number of expansions in the low-pressure cylinder.

The ratio of expansion varies greatly according to the type of engine. In compound engines, the number of expansions may run as high as twelve. In triple-expansion engines the ratio may run to 20 or 25, while in quadruple expansion engines a ratio of 30 has been attained.

Cost of Back Pressure

In agitating the question of back pressure, a recent writer says that there is no doubt but that back-pressure costs money. Let us see how much. We will suppose that we have a 160 horse-power plant. The actual cost of the back-pressure will depend upon the size of the cylinder and the speed of the piston. It will be readily understood that for a given power the speed of the piston must increase as the sectional area of the cylinder diminishes, and if the piston speed remains the same, and an earlier cut-off is obtained, the cylinder must be larger.

We will take an engine of the side valve type, with a cylinder 12 inches in diameter, and stroke of 18 inches, running 125 revolutions per minute. Taking four-fifths of the stroke, or that portion of the return before compression begins, as the effective part of the back-pressure, we will have the piston moving 125 times two and one-third feet, or 292 feet per minute. As the area of the piston is 113 square inches, we have the piston exerting a power of 292x113, or 32,996 foot pounds of work per minute for each pound of back pressure upon the engine. In other words, each pound of back-pressure takes off one horse-power from the effectiveness of the machine, or adds one horse-power to the constant load.

We are doing, then, one horse-power of useless work. On an economical production of steam, with an evaporation of ten pounds of water per pound of coal, and using only thirty-two pounds of water per horse-power per hour, we have a waste of thirty-two pounds of coal per day of ten hours, or five tons a year, costing $20.00; and as this cost increases directly with the pressure, it will cost $100.00 a year to support a back-pres-

sure of five pounds. No account is here taken of water charges, which will also be quite an expense in cases where the water is taken from city water works.

It must be remembered, too, that this expense increases with the size of the engine, and for a cylinder 20 inches in diameter would be very high.

Large Gas Engines

A steady increase in the size of gas engines has taken place since the machine was put on the market in this country, about twenty-five years ago, and now units of over 100 effective horse-power are seen so frequently as to excite no special interest. It is a fact to be regretted, however, that some of the erroneous ideas concerning these machines, derived from ignorance during the introductory period of small engines, still cling to the modern engine and materially impede progress. The worst of these fallacies is probably the one which credits the gas engine with ability to take care of itself. For all the evils following the application of such an idea to engine room practice, the builders are no doubt largely responsible, inasmuch as the circular of a few years ago generally assured the prospective purchaser that the engine described required no care beyond starting, occasionally oiling and stopping. The almost invariable result was that the engine was left to fulfil the promises of the builder under the care of a man, who, if not totally unacquainted with machinery, knew very little about the action of the gas engine.

When the engine was small and the services of a good machinist available in cases of emergency, the engine generally gave good results by virtue of its real merit; but when the same engine room policy came to be applied to larger engines, trouble usually resulted, and dissatisfied users originated the common opinion that gas engines are all right in small size, but large ones are not reliable.

The extremely cheap natural gas in some parts of the country and costly steam fuel in others have led a fair number of good concerns to brave public opinion by installing large gas engines for important duty. In almost every case of this kind, in which careful judgment has been exercised in the selection of the engine, results have been good. These large engines represent a considerable outlay of capital, and as a rule competent men are placed in charge, the wages of such men being easily justified by the increased reliability and economy of the plant.

When a plant is of considerable size it would be well to have indicator diagrams taken at certain intervals, in order to observe the internal action of the engine. By this means a reliable record can be kept of igniter and valve adjustments, and it is very little, if any, more difficult to obtain than one from a steam engine. If indicator diagrams are insisted upon when the engines are bought, the purchaser can always compare the running condition of his engine with its condition when on the manufacturer's test stand. It is, perhaps, needless to say that no reputable manufacturer would be likely to ship an engine from his shop without first testing it with both the brake and indicator, and the records of such tests should be open to examination by the purchaser.

If a gas engine has work to do which is of any importance, it will always pay the owner to assure himself that the man who operates the engine is familiar with every detail of its construction and operation. All adjustments should be made as soon as needed, not postponed until the engine stops nor until it fails to start from lack of adjustment of important parts. Certain parts of every gas engine are subject to wear and are not adjustable. Duplicates of such parts should be kept on hand so far as possible. There are, also, some of the more delicate parts, including springs, which are liable to break, and should always be kept on hand.

The simplicity of the gas engine and the apparent ease with which it can be constructed have led many men to believe that they could improve it. A few have, perhaps, succeeded in some details, and if the remaining part of the engine is good, their efforts are generally successful. These cases are the exception rather than the rule, as a man may be a very good mechanic and machine designer, and yet fail hopelessly from lack of knowledge of the principles underlying the action of the gas engine. An engine which is correct theoretically and shows lack of mechanical skill, is just as bad. Familiarity with the modern practice, knowledge of the theory, and a high order of mechanical skill are absolutely necessary for the production of a well designed gas engine of large size, and the idea that any ordinary machinist can produce such a machine is dangerous. In order to produce a reliable, uniform product at a moderate price, special machinery must be used to a certain extent, and it is well to look into the shop methods of any builder before purchasing an engine from him. A fairly good idea can be formed as to the interchangeability of parts, and this feature is very important.—*Engineering Record.*

The Value of Piston Clearance

Many cylinder heads have been saved and many dangers have been avoided by the care of the engineer in looking out carefully for pistons clearance when making repairs about an engine.

In these days of close calculation, the clearance is so little that every re-adjustment of the rod-boxes and quarter-boxes has a greater effect on clearance than was the case with the old style cylinders, where the clearance often was over an inch—three-sixteenths of an inch is, we believe, now thought to be the thing for cylinders up to sixteen inches in diameter. This small space is often very much crowded with water upon first starting, as the snapping of the valve frequently testifies, and it is well to keep the spaces on each end as nearly alike as possible, or, if any difference, let it be on the piston-rod end.

In case the piston-rod is screwed into the cross-head instead of being keyed, the clearances can be adjusted by that thread very nicely. Sometimes the connecting-rod is so made that one key lengthens and the other shortens the rod. Shims, as the boxes wear away, are always relied upon, but none of these things will, of themselves, make the presence and care of a good engineer of any less importance. It is a good plan to have permanent marks on one of the guide bars to show just what the clearances are. To make these marks, disconnect one end of the rod and shove the piston against the front head and then mark nicely on the guide bar at the front end of the cross-head; then push the piston against the back head and marks again, at the back end of cross-head. Now connect up and turn the engine over by hand, and whatever the cross-head lacks of reaching these marks, will be the amount of clearance between piston and cylinder head. But, in case of a piston-rod screwed in, any change of that screw would make it necessary to go over the whole ground again, and make a new set of marks on the guide bars.

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Philadelphia Engineers' License Law Amended

Philadelphia engineers and the public are to be congratulated upon the action of the legislature, just adjourned, in amending the local license law for engineers so as to require all applicants for license to have had at least two years service in connection with a steam plant before they are eligible for examination. The intention of the amendment is to provide more stringent rules governing applicants for licenses to act as engineers, and to place upon him such restrictions as to insure practical as well as theoretical knowledge.

The law is also amended to divide licenses into two classes:—one for stationary, and one for hoisting engineers.

The principal features of the amendment are as follows: "Licenses so granted shall be graded into two classes, one of which shall entitle the licensee to have charge of or to operate stationary steam boilers and steam engines only; the other of which shall entitle the licensee to have charge of or to operate portable steam boilers and steam engines only; such licenses shall not be transferred from one grade to the other without a re-examination, said re-examination to be conducted without cost to the licensee.

No person shall be eligible for examination for a license unless he furnishes proof that he has been employed about a steam boiler or steam engine for a period of not less than two years prior to the date of application, which must be certified to by at least one employer and two licdense engineers."

Governmental Inconsistency

The Act of Congress making appropriation for the support of the Army for the fiscal year ending June 30, 1904, contains the following provision:

"One hundred electrician sergeants, to be assigned for duty at such places as the Secretary of War may direct, at four hundred and eight dollars each, forty thousand and eight hundred dollars. Provided, that there shall be added to the Artillery Corps twenty-five master electricians, to be enlisted by the Secretary of War, after such examination as he may prescribe, who shall receive seventy-five dollars per month and the allowance of an ordnance sergeant, twenty-two thousand five hundred dollars."

We do not think that the Secretary of War will be overwhelmed with applications under the above mentioned conditions. The industrial world is now sadly handicapped for the need of competent men of this kind, and such men readily command double the salary the Government offers; and with this, the men are wholly independent of discipline, Now where is there any inducement to enter the service—patriotism is a thing the American citizen does not lack in time of need; but it seems very inconsistent in the richest country in the world in making a proposition of this sort.

It is evident that the head of the department asking for men—and expecting to get competent men—for the work mentioned is not a mechanic and probably knows nothing of the requirements of the position.

We would recommend a reconsideration of this provision if the Government really wants electricians.

More Light on Tesla

American electrical apparatus manufacturers and mechanics will be interested to know that the much vaunted "Split Phase" system of "Tesla's" is not Tesla's after all. In a decision of the United States Circuit Court of Appeals, Justice Townsend presiding, a decision was handed down that this invention of Tesla's was anticipated by the Italian Galileo, Ferraris, who disclosed it in a lecture reported and printed some months prior to the filing of Tesla's patent application. A peculiar phase of the case was the failure to put Tesla on the witness stand to prove the case of the complainants. Following this decision, dismissing the complaint, is another with similar conclusion, by the U. S. Court of Massachusetts. We think the plaintiff (who purchased the Tesla patents), and the Courts, have now the same opinion of Tesla as that formed by the technical press years ago.

Dispelling a Popular Delusion

Frequently we hear engineers discussing whether or not more steam is used when an engine is run faster where neither the back pressure or the cut-off has been changed. Indeed, there are many who hold fast to the idea that since the cut-off remains unchanged no more steam is used; hence, if it were possible to make an engine run faster without changing the cut-off we would be gaining a considerable increase in power without a corresponding increase in steam consumption.

The speed of an engine, almost any engine, may be increased without making any change in the cut-off, and, of course, gaining in power. Now it surely takes no Solomon to see that with a more rapid stroke we must have a more rapid consumption of steam it is utterly impossible to get something for nothing out of a steam engine, or any other appliance. The only way a steam engine can be made to do greater work without greater steam consumption is to increase the efficiency of the engine. One thing we must know is that when we only increase the speed of an engine and leave the rest of the mechanism the same there can be but little increase in its efficiency.

Certainly the condensation is decreased with the increase in speed, but the decrease is so slight that it becomes worthy of little consideration in most cases. When an engine is cutting off at a certain part of the stroke, it uses at every stroke a certain weight of steam, depending upon the initial pressure of course, along with the clearance volume and the point of cut-off. If the engine makes 400 strokes per minute (200 revolutions if a double acting enigne) the weight of steam used must be 400 times the weight used per single stroke; but if the engine be made to make 500 strokes per minute, the weight of steam used per minute, neglecting the small difference for condensation, is 500 times the weight used in one stroke.

New Haven's License Law

The ordinance which has just been passed by the board of Aldermen, of New Haven, Conn., to provide for the licensing of engineers in that city, is, on the whole, a possible menace to the engineers of that city, though as to whether or not the measure will result in benefit to the profession, will depend upon the board of examiners, to whom a great deal of power is given.

The fact that an engineer is required to secure a new license each time that he changes positions, though admittedly fair in principle, might in practice prove a menace to one who for some cause had incurred disfavor with one or more members of the board. Of course, this is not likely to happen; but it is an ever-present danger which may serve at times to prevent men from accepting offers of better positions.

Another feature of the law is that but one of the members of the examining board is required to be an experienced engineer—the other two may at the discretion of the Mayor be a surgeon and an undertaker, and the fact that they serve without pay is suggestive.

Smoke Statistics

The smoke nuisance is far from being a modern annoyance; as a matter of interest in that connection it is worth making note of the following:—

About six hundred years ago, so Mr. Durfee said in recently speaking of the subject, when the population of London did not exceed 50,000, its citizens petitioned King Edward I. to prohibit the use of "sea coal," and he responded by making its consumption a capital offence. His successors, however, were more merciful to the users of coal, and its employment was resumed; but again, in the reign of Elizabeth, there were loud complaints against it, and, in 1661, John Evelyn, in his *Fumifugium*, laments that, "owing to the increase of coal smoke, the gardens no longer are fruitful." In the centuries that followed there were a number of parliamentary inquiries and some legislation intended to mitigate, if not remove, the evil, but, nevertheless, the consumption of bituminous coal has rapidly increased in London, and the inquiries and legislation relative to it have all ended—in smoke.

Mr. Charles S. Powell, who has been associated with the Westinghouse electric interests since 1893, and who, for the past six years, has been manager of the Cleveland office of the Westinghouse Electric & Mfg. Company, has changed the scene of his activities from the United States to Europe. He has been appointed Assistant Manager of the British Westinghouse Electric & Mfg. Company, Limited, and has already entered upon the duties of his new position. Mr. Powell, who was one of the most popular men in the electrical business in the United States, is bound to be equally well liked in Great Britain. His headquarters are in the Westinghouse Building, Norfolk Street, Strand, London, W. C.

A new idea is to be tried on an 105 mile line in Mexico. Steel towers will be placed 440 feet apart and strand-cable will be used to convey currents at 60,000 volts. It is hoped to do away with the many disadvantages pertaining to the present systems.

Another interesting experiment was made at Montreal recently, caused by a portion of a dam giving way. The owners—the Montreal Light, Heat and Power Co.—utilized several of their other power stations and accepted the aid of their competitors to supply the imperative needs of Montreal. Some of these stations generated by water and others by steam power; some used two and others used three phase system. Through ingenious combinations the various units and systems were harmonized and worked harmoniously. No one knows what can be done until he tries.

Engineers' License Law for New Haven, Conn.

The engineers of New Haven, Conn., have succeeded in having the following ordinance passed ph the board of Aldermen of that city.

AN ORDINANCE.

Concerning the licensing of Engineers and the Operation of Steam Boilers.

Be it Ordained By the Board of Aldermen of the City of New Haven:

SECTION 1. No person shall be the engineer of, or shall have charge of or operate any steam boiler or steam engine, in the City of New Haven, for a period exceeding one week, who shall not have a license certificate authorizing him to have charge of or operate, such engine or boiler, from the Board of Examiners hereinafter constituted.

SEC. 2. The Mayor shall, within sixty days after passage of this ordinance, appoint a Board of Examiners, which shall consist of three members, one of whom, at least, shall be an engineer who has had ten years experience in the operation of steam boilers, or steam engines, who shall hold office for a period of two years, or until their succes- sors are appointed, and shall grant the license hereinafter provided for, and serve without pay.

SEC. 3. Before any person shall be employed as an engineer of any such steam boiler or engine, or shall have charge of or operate any such boiler or engine, he shall make a written application to said Board of Examiners for the license hereinbefore mentioned, and shall specify in such application the particular engine, boiler, or plant which he desires to operate or have charge of, which application shall be accompanied by references as to his character and ability, and the filing of such reference with such said Board shall be considered as a compliance with the provisions of this ordinance, for thirty days thereafter, or until his said application shall have been passed upon by said Board, and said applicant, after the filing of said-references, shall have the right to operate and have charge of any such engine, boiler, or plant, until his application shall have been passed upon by said Board.

SEC. 4. Every person who shall satisfy said Board of Examiners that he is a safe and competent person to operate and have charge of the steam plant, boiler or engine specified in his application, shall, on payment of One (1.00) Dollar, receive a license permitting him to operate the same for one year, unless sooner revoked. Said license shall apply only to the plant, boiler, or engine for which it is issued; and before taking charge of another plant, the licensee shall apply for another license for such other plant, for which other license, if the application be made within a year, no charge shall be made. For annual renewals of such licenses, a fee of one ($1.00) shall be paid. For the renewals above mentioned, no additional hearing shall be required, unless in the judgment of said Board it shall be necessary. Said licenses must be framed and hung in a conspicuous place in the plant, or upon or near the engine for which it is issued.

SEC. 5. Said Board may at any time revoke any license issued, on account of inebriety, incompetency, or negligence of the holder of any license, or for any other good cause, and no license shall be issued to any licensee whose license shall have been revoked, during the next six months ensuing, after which time the license revoked may be renewed, if, in the judgment of the Board, the cause of its revocation no longer exists.

SEC. 6. If said Board shall refuse to grant to any applicant a license, no license shall be issued to him for the next six months following the refusal of his application, but after said period said applicant may make another application, and if found qualified, may be granted a license.

SEC. 7. Whenever said Board shall refuse to grant any application, or shall revoke any license they shall give immediate notice of such refusal, or revocation, to the applicant or licensee, and such applicant or licensee may appeal from the decision of such Board to the Mayor, in which case said applicant or licensee shall file his appeal with the Mayor within ten days after receiving notice of the decision of said board, and the Mayor may confirm or reverse the decision of said Board, and issue, such license.

SEC. 8. Any person found guilty of any violation of the provisions of this ordinance, except Section 10 thereof, shall be fined not more than Twenty-five (25.00) Dollars, nor less than Ten (10.00) Dollars.

SEC. 9. This ordinance shall not apply to Railway locomotives, nor engineers employed thereon, nor to steam vessels coming under the jurisdiction of the United States Board of Supervising Inspectors, when employed upon the vessels to which said license applies. Nor shall it apply to boilers in private residences or buildings for heating purposes, unless in the opinion of said Board, such boiler is so equipped and run as to endanger public safety unless operated by a licensed engineer.

SEC. 10. Any engineer in charge of any steam engine who shall abandon it while in operation, without leaving a person in charge of the same, who shall, in the opinion of the employer of said engineer, or of the owner of such engine, be competent to take charge of the same, shall be fined not more than Ten (10.00) Dollars.

SEC. 11. This ordinance shall take effect within sixty days after its passage.

A straight-line engine in use at the works of the Solvay Process Company at Syracuse, N. Y., recently completed a run of 22 months without a stop. Its speed was 250 turns per minute and this makes something over 237,500,000 turns without a stop.

What is Electricity?

A. G. WILLIAMS.

To answer this question in a simple, practical manner, so as to be understood by practical engineers, is my aim.

Every engineer is more or less familiar with the dynamo.

In last month's issue of the PRACTICAL ENGINEER appears an article, entitled: "The simplicity of the dynamo." "The whole thing may be compared in its principles to the working of a steam pump forcing water through a line of pipe of the same extent as the line wires. The dynamo (or pump) forces electricity instead of water."

Where is that electricity forced from? It is drawn from the atmosphere in an inexhaustible, never-failing stream by the dynamo, which may be driven by wind power, and thus nearly approaches the idea of perpetual motion. The air in motion supplies the force which extracts the electro-motive froce from itself. Of course, any other applied force, such as steam, gas or water engines, will perform the same function.

The atmospheric charge of electricity would naturally become exhausted were it not for its circulation from pole to pole. The atmosphere is a huge transformer. A transformer is neither more nor less than a condenser. To fulfill the conditions of a condensor we must recognize the earth as the interior lining of the Leyden jar, the atmosphere as the insulating medium, the outside limits of the atmosphere and surrounding ether or space the positive charge of electricity. The atmosphere, however, is not a perfect insulator—it constantly varies in the ratio of its temperature and density. It is ever contracting and expanding. Its capacity varies in unison as it is dry or moisture laden. The outside space, or interstellar medium, is one illimitable ocean of static electricity in which our globe is poised.

The static electricity from space presses upon the atmosphere with a tremendous force and filters through it under ordinary conditions. Clouds are faults in the atmospheric insulator, and set up a local action disturbing the normal flow, and act as con densors, become overcharged and are attracted to the earth's surface and suddenly discharge the accumulated electricity in the lightning flash, thus restoring the equilibrium.

The earth is thus a magnetic spheroid, and derives its magnetism from the surrounding electrical ether.

The earth, again, is a globe-shaped dynamo, revolving with inconceivable rapidity at a speed of 24,000 miles per day, or about 17 miles a minute, 17 times as fast as our fast express trains and 60 times faster than a dynamo making 1000 revolutions per minute in the proportion of its diameter. The electromotive force to drive our terrestrial dynamo is displayed to our vision in the shape of the Aurora Borealis and Australis. Two enormous sheaves of electricity pour upon the earth's poles, covering some hundred thousand square miles of surface at each pole.

We are familiar with the terrific power of a single flash of lightning—what must be the power exerted by a constant stream of lightning pouring upon the earth's polar regions over 100,000 square miles in radius?

The magnetic needle points to these two electrical zones. The globe responds to this huge whirlpool, or rather electrical whirlwind, emanating from the ether, by rapidly rotating on its axis in exact accordance with the law of electro-magnetic rotation and exactly as the dynamo rotates by applied force. The immediate result is the development of heat. The earth temperature is raised, the interior is a molten sea of melted matter evidenced by volcanic eruptions. The earth's surface quivers under this tremendous spead of rotation evidenced in earthquakes, the ever restless ocean, with its ever-flowing tides, streams and waves; the air is ever in motion, not a quiet spot anywhere.

The earth's heat is generated by friction against space, which is itself a rigid quantity. A magnetic field is the exact condition of the ether.

In this manner only can we account for the motion of our globe on its axis and answers the great question of the day—What is electricity?

In conclusion, I can only recapitulate the foregoing by stating as my firm and unshaken theory that electricity is the great primary energy which sways the whole universe.

The sun is a huge incandescent spherical electric light, its mass is ignited by its tremendous velocity of rotation in a magnetic ether. Our earth a dynamo actuated by the same force in common with all other rotating bodies. Our dynamos are puny imitations of these same grand phases of energy. Cosmic force thus exerts itself throughout the boundless realm of the ether—never begun, never ending, inexhaustible as the unlimited depth of space.

Electricity the primary force—Heat, a development or secondary Light—a result of the tertiary resolving again into the primary—three in one, yet three phases of indistructible energy.

Matter by resistance or inertia is set in motion, heat and light developed.

Were it not for the earth's internal heat, the atmosphere would become a solid frozen substance, solidified by the intense frost of space. Just as long as our globe revolves on its axis as an electric dynamo will it be a habitable sphere. When it ceases to move it will become a stationary fixed magnet. This is the condition of our moon. Motionless and frozen, no air surrounding its icy surface, a dead world, merely reflecting the sun's light upon our earth. It has succumbed to our earth's superior dynamic force just as a large dynamo arrests the motion of a smaller.

Electricity exists everywhere in the boundless starry vault of space—in the air we breathe, in the depths of the ocean and earth.

Is not electro-magnetic action the very essense of motion and from which we draw *all* our sources of energy?

Is it not the sustaining energy which maintains the universe as an infinite expanse, studded with bright stars or suns, shedding their rays of heat and light upon millions of worlds like ours, rendering them habitable globes, fit for life in an infinite array?

The blue vault of the sky, in which the telescope displays to our wondering eyes, is large enough to hold and must supply an inexhaustible energy. If examined carefully the law of conservation of energy will resolve into a realization of the fundamental principle governing the cosmic energies. Expansion and contraction is ever at work exactly as a steam engine works, but the power is never lost nor wasted.

Matter and motion are indestructible. We can see both of them. Matter, represented by the earth we live in, never in motion; motion, in the all pervading electricity.

Electricity from this point of view is the life of suns and planets, which act and react upon each in an endless chain.

Space is intensely cold. Matter in motion is heated. Therefore constant antagonism is going on between the cold of space and the heated matter, contraction and expansion, the eternal Law, and set in motion by the great primary force of Electrodynamics A. G. WILLIAMS.

LETTERS FROM ENGINEERS

IN ORDER to make this department of THE PRACTICAL ENGINEER as interesting as possible, a moderate rate will be paid by us for all contributions published under this heading. However, we do not assume responsibility for the ideas or opinions expressed. None need hesitate to contribute because of inability to draw or write well. We will redraw or revise whenever necessary—it is the idea we want. New ways of doing old things, criticisms of accepted theories, and general engine-room experiences are especially solicited.

Soft Coal and Forcing Boilers

EDITOR PRACTICAL ENGINEER:

We see in the different technical journals many advices concerning the subject of forcing boilers; now, I will say that very much depends upon the engineer and fireman, and also the design of the boilers which are forced, if they must be used in this way.

In one place, of which I know, there are two cast-iron sectional boilers of the safety type—one rating at seventy-five and the other at one hundred and twenty horse-power. The boilers are used for power, heating, cooking and drying; hence, the amount of steam used may vary from one hundred and seventy down to forty or fifty horse-power.

In proof of my statement above that much may depend upon the engineer, or fireman, I will quote the results obtained by two different men at this plant under exactly the same conditions. One man ran the plant for two years, and during that period the boilers were rarely free from leaks, were in constant need of minor repairs, and in the winter he could scarcely maintain sufficient steam pressure to supply the demand. The present engineer has run the plant for the last two years and has saved twenty per cent. (actual count) in coal. The boilers have not leaked, he has never been required to run both boilers at once and has had no repairs beyond what he himself has been able to do.

Such a difference in results under like conditions must have a reason, and the reason is very simple. The former engineer used to permit soot to collect all over the heating surface of the boilers on the outside, and he made no attempt to get rid of the scale and sediment upon the inside surface; consequently there was numerous burnt out sections to replace. Then, again, there is a portion of each night when steam is not used; in such a case it was the habit of the night man to close the ash-pit doors, cover the fires with coal, leave the fire doors wide open and the dampers nearly so; thus, in about two hours, the pressure was gone and the fires nearly so. When steam was wanted there was always a hustle and a forcing of the fire to get up steam. This caused unequal expansion and contraction, useless waste of fuel, occasioning leakage.

The present system of leaving the fire in the period of non-use is to cover the fires with coal, the ash-pit doors closed, the dampers nearly so, being opened just enough to carry off the gases, and the fire doors opened just enough to prevent blowing off steam. By this method a good fire is ready at a moment's notice and also a working pressure of steam.

During the last coal strike it was necessary to use soft coal for firing, and it did not seem difficult to force the boilers up to 50 per cent. above their rating so long as the heating surface was kept free from soot. I am of the opinion that equal results can be had with soft coal, ton for ton, over hard coal, only greater care must be observed in its use.

Vibration in a boiler is also a bad feature, but it may be largely overcome by placing a large separator between the engine and boiler. WALTER S. GRISCOM.

Hints on Using Indicators

Don't try to balance a double acting engine or to weigh its load with one indicator. Even an indicator cannot be in two places at one time.

Don't be too lavish in the use of leading pulleys. A little ingenuity will enable one in almost every instance to so arrange a reducing motion that the cords may be led directly to the indicator, and all the additional bother of pulleys and their supports, as well as what is of greater importance, the inaccuracy due to the stretch of the cord, avoided.

Annealed iron wire is better than any cord which has ever been made for connecting the indicator with the reducing motion, and the price of one hank of cord will buy a supply for years of active service.

Don't have a long, heavy lead to vibrate upon the end of your pencil lever. Break off all except what is necessary to draw the card, and file that to a fine but smooth point.

Take the atmospheric line directly after the card is taken and before the spring has time to cool. There is quite a difference in the position of atmospheric lines when the spring is cold and when it is hot.

When making a test or adjusting an engine it pays to keep an accurate record of each step which is made and every controlling circumstance. The value of a test does not alone consist in the determination of the result sought for, but a test made to determine one thing often furnishes the data for other matters, is of value in many ways for reference, and is of the more value the more complete the data which accompany it. When making changes in the adjustment of an engine, always keep a pair of cards showing the engine "as found," and take a pair after each alteration, recording upon them the changes which have been made so that any step may be retraced on the whole record reviewed.

Do not depend altogether upon the indicator in setting an engine, but use a little horse sense with it. See where your valves and connections are before you start, and be careful where you get them. An engine can make a good looking card when it is in a condition unfit to run.

The functions of the steam engine indicator are to show by its diagrams the pressure of steam at every part of the stroke, the amount of lap and lead of the valve, point of cut-off, average pressure, counter pressure, point of exhaust opening, point of exhaust closure, and amount of cushion, enabling the happy possessor to calculate the power of his engine, amount of work it is doing at the time diagrams are taken, frictional load and thoeretical rate of water consumption.

A close approximation to the theoretical diagram, high initial pressure, early cut-off and low terminal pressure, indicate good construction and performance.

Indicator diagrams show the pressure in the cylinder by the relation of their lines to the atmospheric line, which is a line drawn when the indicator piston is in equilibrium, having the pressure of the atmosphere on both of its sides.

The diagram shows by the changes of direction of its lines the exact time, in relation to the stroke of the piston, that each event of the valve-stroke, admission, cut-off, &c., occurs.

QUESTIONS and ANSWERS

THE editor will be glad to receive from the readers of THE PRACTICAL ENGINEER, such questions relating to engineering subjects, as may, from time to time, occur to them. All questions and answers should be addressed to the editor and accompanied by the name and address of the writer, which will not be published, however, unless especially desired. It is the intention that questions shall be answered by the readers, and even though the editor may, from time to time, publish answers and questions, he especially desires the readers in such cases to contribute any further information, in connection with the points raised, that they may consider of interest. All questions and answers received by the editor will be published, as far as practicable, but he reserves the right of editing or rejecting any communication.

EDITOR PRACTICAL ENGINEER:

Wil you please answer the following questions for me? 1 What is power? How is it measured? 2. How is it that you can run an engine with 60 lbs. steam pressure and pump against a head pressure of 275 or 300 lbs. in the compressor of an ice plant? 3. Using an injector, how is it that you can take the steam from one boiler, at 60 or 70 lbs., and fill another boiler in which the pressure is 100 or 150 lbs? 4. What is a right-hand engine, and what is a left-hand engine, and why are they so called? T. B. H., Philadelphia, Pa.

[1. Power is the term applied to the rate of doing work. Thus, in order to determine the power of a machine, it is necessary to know three things; first, the force acting; second, the distance through which it acts; third, the time during which it acts The product of the force and the distance is the work done, and the work done, divided by the time, is the power. Thus, if an engine hoists a weight of 30,000 lbs. a distance of 11 feet, the work done is 11x30,000=330,000 foot-pounds. Now, power is usually expressed in foot-pounds per minute, 33,000 foot-pounds per minute being one horse-power, the unit measure of power. Hence, if the above work is done in 10 minutes, the rate of doing the work is 330,000÷10=33,000 foot-pounds per minute, and the power of the engine is therefore one horse-power, since 33,000 foot-pounds per minute represents one horse-power.

2. If you will notice carefully, you will see that the area of the steam piston is much larger than the area of the compressor piston. Furthermore, the mean effective pressure in the steam cylinder is greater than the mean effective pressure in the compressor cylinder. Consequently the total mean effective pressure upon the steam piston is greater than the total mean effective pressure upon the compressor piston, and hence the former overcomes the latter.

3. When the steam issues from the convergent nozzle of the injector it is in the form of a jet. The weight of the steam composing the jet is small, but its velocity is extremely great. Now, as soon as this jet meets the cold feed-water, it is condensed. In condensing, and in mingling with the feed-water, the velocity of the jet is considerably reduced, yet is still quite high. The column or jet of steam when in motion had comparatively little kinetic energy because of its small weight. However, in condensing and mingling with the cool feed-water, the jet has changed from steam to water, and at the same time it has entrained a considerable amount of feed-water with it. Instead of a jet of steam moving at an extreme velocity, and possessing little energy, we now have a column of water, of appreciable weight, moving at a high velocity, and hence possessing much more kinetic energy than did the jet of steam. The water in the boiler is stationary, or very nearly so. Therefore it possesses no kinetic energy. The moving column from the injector does possess energy. Therefore it is a comparatively easy matter for the moving column to force its way into the water in the boiler, notwithstanding the greater steam pressure in the boiler being fed.

4. Stand at the head end of the cylinder and look toward the centre line of the cylinder, it is a right-hand engine. If the crank is to the left of the centre line of the cylinder, it is a left-hand engine. The purpose of so naming them is merely to distinguish one from the other.—EDITOR].

EDITOR PRACTICAL ENGINEER:

Will you please tell me how to increase the power of a Corliss engine? T. D. G.

[There are three ways in which this can be done. Take, for example, a 24 x 48 simple Corliss Engine making 70 revolutions per minute, the boiler gauge pressure 80 lbs. per square inch, one-quarter cut-off, or cut-off 12 inches from the beginning of the stroke; the mean effective pressure, say about 42 lbs. per square inch, the governor pulley on the main shaft 10 inches in diameter, the pulley on the governor shaft 7 inches in diameter, and the friction of engine, cylinder clearance, condensation, etc., left entirely out of the question. It is desired to increase the speed of this engine to 80 revolutions per minute, and in this manner increase its horse-power.

FIRST METHOD:—Regardless of piston rod, the area of the piston is 452.4 square inches nearly. The piston speed of this engine is 560 feet per minute, and its horse-power 322 nearly, Thus: 452.4x42x560 divided by 33000 equals 322. So that the horse-power of this engine at 70 revolutions per minute is 322, nearly, and this is what the manufacturer's catalogue gives. Now, in order to get 80 revolutions per minute, take the 7 inch pulley off the governor shaft, and put in its place an 8 inch pulley. Thus: 70 is to 80 as 7 is to 8. Then, the governor balls will revolve in the same relative plane that they did before, and the cut-off will remain the same; that is, at one-quarter, or 12 inch of the stroke. Thus, 7 is to 10 as 70 is to 100. And 8 is to 10 as 80 is to 100. So the governor balls make 100 revolutions per minute, both before and after making the change.

Now, with the engine speeded up to 80 revolutions per minute, we get 46 more horse-power. Thus: Piston speed equals 640 feet per minute. Then, 452.4x42x640 divided by 33000 equals 368 horse-power, nearly. And 368 minus 322 equals 46. Now, it would appear that we are getting 46 horse-power more for nothing, but such is not the case. For, 452.4x12x2x70 divided by 1728 equals 439.8, or nearly 440 cubic feet. of steam per minute, at 80 lbs. boiler pressure, are required to develop 322 horse-power. And, 452.4x12x2x80 divided by 1728 equals 502.6, or nearly 503 cubic feet of steam per minute, at 80 lbs. boiler pressure, are required to develop 368 horse-power. Then, 503 minus 440 equals 63 cubic feet more of steam at 80 lbs. boiler pressure, which means

more water evaporated per minute and more coal burned per hour.

SECOND METHOD:—Retain the same engine speed and the same cut-off, but increase the boiler pressure from 80 to 90 lbs. Then 80 is to 90 as 42 is to 47 plus, call it 48 lbs. mean effective pressure. Then 452.4x48x560 divided by 33000 equals 368 horse-power, nearly, the same as before, and as given in the manufacturer's catalogue. We are now using 440 cubic feet of steam per minute at 90 lbs. pressure with an increase of 6 lbs. M. E. P.; consequently, more coal per hour must be burned.

THIRD METHOD:—Retain the same boiler pressure, that is 80 lbs. and weight the governor so as to make the balls revolve in a lower plane in order to give a later cut-off. Thus, 322 is to 368 as ¼ is to 2-7. That is, the cut-off must take place at about 2-7 of the stroke instead of at 1-4. Then, 1-4 is to 2-7 as 42 is to 48. That is the M. E. P., will be 48 lbs. per square inch with a cut-off at 2-7 of the stroke. Then, 452.4x48x560 divided by 33000 equals 368 horse-power, the same as before. But 2-7 of 48 equals 13 5-7, or 13.71 inches nearly, so that, instead of cutting off at 12 inches with 80 lbs. boiler pressure, we are cutting off at 13.71 inches and using 63 cubic feet more steam per minute. Thus, 452.4x13.71x2x70 divided by 1728 equals 503, nearly. And, 503 minus 440 equals 63, that is, we must use 63 cubic feet more of steam per minute at 80 lbs. boiler pressure, in order to get 46 more horse-power, which means the evaporation of more water per minute, and the burning of more coal per hour.]—EDITOR.]

EDITOR PRACTICAL ENGINEER.

I have a drum armature and when testing with a magneto bell, if the terminals of the bell are placed upon any two of the segments of the commutator, it will ring the bell. So far as I know the commutator is in good shape. What is wrong in the armature coils?

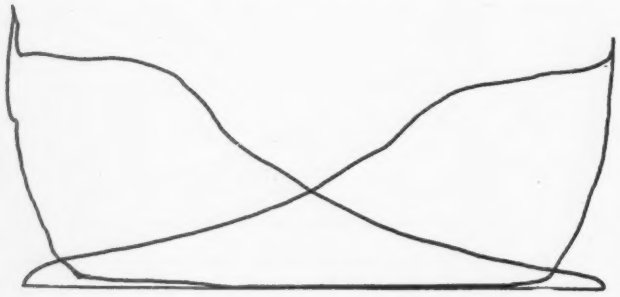
The dynamo is a two and one-half K. W. Eddy machine. I have never seen it in operation.

P. H. WILLIAMS.

This does not show that anything is the matter with the machine. What you have mentioned is characteristic of that type of dynamo. Speed it up to the proper voltage and you will find it all right probably.—EDITOR.

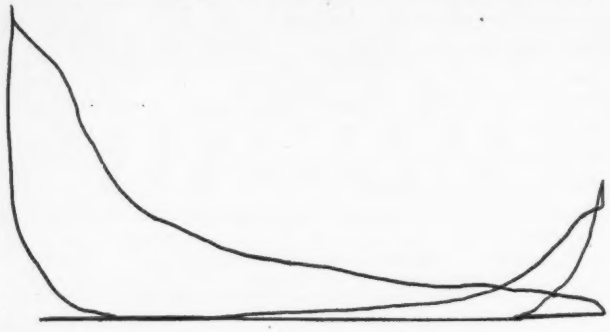
EDITOR PRACTICAL ENGINEER.

Enclosed you will find two indicator cards taken from a Fitchburg engine with the old style valve gear. One



was taken under full load and the other while running light. What is the cause of the light card not being equal on both ends? R. E. W.

In reproducing the heavy load card we did not observe a faint line on the right which showed a late adimssion of steam. However, it is noticeable on the light card, where the line drops and then takes steam driving it



across the expansion line. The cause of the inequalities is probably that the govenor is not in proper balance—the tension being so that at one portion of the revolution the weights pull forward and at the other they lag.—EDITOR.

The Vigilant Feed Water Regulator

Boiler owners seldom realize the enormous amount of energy stored in a boiler charged with the average steam pressure, unless they have seen the havoc from a boiler explosion. At the present time with the large factor of safety with which they are designed, and the careful yearly inspections most boilers are submitted to, it may safely be said that the predominating cause of explosions of this type now-a-days is low water. It is not to be understood by this that the water is always permitted to become so low as to allow burning the crown—sheets such is not the case. But, the water is permitted such a varied range in the boiler by letting it run pretty low then filling it to the limit of safety, that the material is subjected to the widest possible variations in expansion and contraction. This action going on from day to day finally terminates in a rupture of greater or less degree; henee the value of maintaining a fixed water line. The above is, of course, the principal reason for maintaining an even temperature, namely, the safety of life and property—but there are many features in the line of economy which prevail when a fixed water line is maintained. There is protection from priming, saving in fuel, etc.

The value of automatic machinery has come to be generally recognized, operating with a precision and regularity which cannot be attained by hand operation. To insure against all human fallibility in assuring a fixed water level in boilers the Chaplin-Fulton Mfg. Co., Pittsburg, Pa., have placed upon the market the Vigilant Feed-Water Regulator. This appliance not only maintains a fixed water line but does it automatically in a manner which precludes all danger from derangement of the mechanism. These machines are not an untried quantity, many leading manufacturers having adopted them.

The principle on which the apparatus is based is the difference in weight between a body suspended in steam and suspended in water, which is of course equal to the weight of the water it displaces.

The Regulator consists of three parts. The first is a special bent brass nipple and gate valve, which is screwed into the water column at the point you wish to carry your water level.

From that a three eighths inch pipe connection is made to the top of the hooded chamber.

The second part of the apparatus is a hooded chamber as shown.

This is placed as close to the column as possible, with the bottom of the chamber eight inches to ten inches above the point at which you desire to carry the water level. A one and one-fourth inches connection is made from the bottom of the chamber to the boiler or to the bottom connection to the water column.

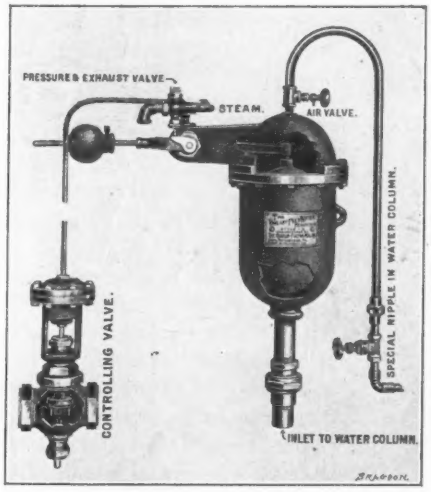
On the top of the hood is a small pet cock for blowing out any accumulation of air.

Inside the chamber is suspended a weight which is hung from the end of a lever, whose fulcrum is a shaft, one end of which extends through a stuffing box, while the other rests on a step inside.

To the projecting end of this shaft is keyed another lever which carries an adjustable counterweight, and at the fulcrum has a shoe with an adjustable set screw for lifting the stem of the actuating valve.

This valve is attached to the top of the hood, and a steam connection made to the gauge pipe or other point where dry steam may be obtained. The valve has an upper and lower seat so arranged that when against the upper seat the steam connection is shut and the bottom one is open to the atmosphere. When seated on the bottom seat the connection to the air is shut and the steam pressure is admitted to the controlling valve.

The controlling valve is the third part of the regulator and is placed in the feed line to the boiler. In construction it is similar to a check valve, and the entering water tends to lift the valve. A stem extends from the valve through a stuffing box to a hood, which has a mushroom top on which rests a diaphragm. The cap above the diaphragm forms a reservoir for water, which prevents the hot steam reaching the rubber diaphragm and burning it.



Vigilant Feed Water Regulator

Under the mushroom is a spring which tends to open the valve when there is no pressure on the diaphragm.

When the water level is below the opening of the special nipple the regulator chamber will be full of steam, and the water in the pipe to the chamber will be the same height as in the column. The weight in the chamber is then heavier than the counterweight, and the latter will be in the top position and the actuating valve held against its top seat, and the exhaust will be open to the air. There can then be no pressure on the diaphragm, and the controlling valve will be wide open and the boiler taking water.

When the boiler fills up to the opening of the special nipple the steam will be cut off from entering the chamber, and the steam which was in it condenses and makes a vacuum so that the water from the boiler instantly fills it to the top.

The inside weight then weighs less than it did when it hung in steam by the weight of the water which it displaces. The counterweight is now heavy enough to over-balance the inside weight and goes down, while the inside weight goes up.

As the inside lever goes up the actuating valve goes down, opening the steam connection and shutting the exhaust.

This admits the steam pressure to the diaphragm chamber and forces the controlling valve down, so that the feed-water is shut off at once.

No more water can enter the boiler until the water level falls to the opening of the special nipple, when steam is admitted to the top of the chamber, the water in it falls to the old level, all the operations are reversed and the controlling valve opens again.

These operations are repeated as the water gets above or below the desired point and the variation does not exceed one-half inch. When the counterweight is up you know the boiler is feeding, and when down that it is not.

Pulverized Coal

The Indianapolis, Ind., Water Company has constructed a plant to pulverize coal for the use of its Riverside pumping station. Much of the machinery is now in position.

L. K. Davis, engineer, says the scheme is his invention. The plan is to use pulverized coal, much the same as gas would be used. Remnants of the sort of coal that costs $1.90 a ton in the lump are bought at the mines for thirty cents a ton. It costs fifty cents a ton to transport them and about twenty cents a ton to pulverize them. After they are pulverized, Mr. Davis says, they make a heat just about thirty per cent. more intense than lump coal, for they are pure carbon.

The coal is first dried, then crushed with steel balls. Then it passes to a tube mill, where flint pebbles are used, and the coal is pulverized until it is nothing more than dust. Then it passes from the plant and, by the use of compressed air, is forced through pipes about 3,000 feet to the pumping station engine room. The fires have to be attended in much the same manner as natural gas fires.

The plant being erected will have a capacity of 140 tons, and it is expected that some of the product will be offered for sale.—*The Economist.*

In the face of death, Clinton Yoder, 26 years old, attempted to stop a runaway stationary engine in the machine shop of the United States Steel Corporation, Youngstown, Ohio, that would have killed or maimed several of his fellow employes.

Before he could get the steam shut off the ponderous flywheel burst, and he was struck by a piece of metal and killed.

About a dozen workmen were standing near the big engine when something went wrong. The ponderous drivers began to whirl around at lightening speed. Yoder rushed to the engine and had just grasped the wheel to turn off the steam when the wheel flew to pieces. Yoder's skull was crushed, but none of the other workmen were injured.

A portion of the building was torn out, and pieces of the wheel were thrown 200 yards.

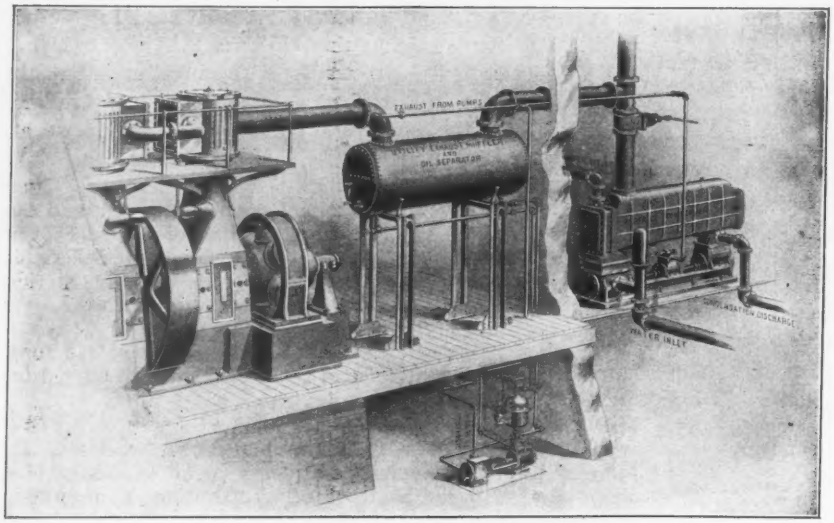
Test of an Appliance for Extracting Oil from the Exhaust of a Condensing Engine

Made by Prof. F. R. Hutton of Columbia University and Secretary of the American Society of Mechanical Engineers.

Many large power plants using surface condensers have been wasting the condensed water on account of the presence therein of cylinder oil. The great value of this condensed water is best evidenced by the large amount of money and effort that has been expended in devising apparatus for separating the oil from it, thus permitting it to be used over again without injury to the boilers, thereby effecting a big saving in water by using it over and over again. Then again there is an equal or greater benefit accruing from the elimination of the scale evil in thus using perfectly pure water. But, before this water is used the oil should be removed to a certainty. Failure to get rid of the oil accounts largely for the use of "Jet" instead of "Surface" condensers in many plants.

The "Utility" oil separator has been in service for several years and is now installed in scores of representative plants in and around New York City. The manufacturers guarantee that this separator will so thoroughly purify the exhaust steam, that all condensation can be returned to the boiler without injury, thus effecting a saving in both coal and water bills. These claims, they say, have been frequently substantiated by prominent chemists who have analyzed the condensation, as well as in years of actual practice. Recent discussions before the American Society of Mechanical Engineers showed the necessity of considerable education on the subject of oil separators, therefore the following will be of general interest to all engines and steam users.

The first test made for oil separation of a "Utility" connected



Utility Oil Separator Installed

between engine and condenser was on March 24th, 1903. This test was made by Prof. F. R. Hutton, member of the American Society of Mechanical Engineers. In this installation, a standard size of separator was used for a 12in. exhaust pipe and was 40 in. in diameter by 96 in. long. The space between nozzles, about 60 in, is filled with a series of baffling or separating plates made with iron and suspended in semi-circle frames. Under the temperature, the oil and water arrested by the chains must drip to the pump governor, as shown in figure, and is pumped to the sewer.

As double the ordinary quantity of oil was fed to the engine in the second test and the result of 99.9992% oil separation was shown in both tests, the manufacturers feel that there can no longer be any doubt but that the exhaust condensation from a surface condenser can be returned to the boilers with absolute safety.

The following is the report made by Prof. Hutton as a result of the above mentioned test.

Standard Steam Specialty Co., 111 Fifth Avenue, New York City.

Gentlemen:

I present you herewith, report on tests made upon "Utility Oil Separator" attached to a condensing engine.

The engine was a 250 H. P. Ball Engine, at the Brooklyn Navy Yards. Two tests were made. In the first one a half pint of oil (7.75 oz. or .4843 lb.) was sent through the lubricator of the engine during an hour's run, and in the second test an entire pint of twice the amount of oil used in the first test was passed through the engine in the same time. The "Utility Separator" was connected to a 12 in. exhaust pipe, between the engine and a surface condenser, and by means of samples of water containing the oil separated from the exhaust steam were taken from the separator and samples of the condensed water were taken from the condenser after the separation of the oil. These two samples have been analyzed by a competent chemist and the quantity of oil ascertained in each sample. By comparing the amount of oil in the sample and the amount of oil which passed through the engine, and the total weight of steam condensed, and water withdrawn from the separator, the result shows that in the first test 90 per cent of the oil was caught in the "Utility" Separator and that of the mixture of water and oil issuing from the condenser only .0008 per cent. was oil. That is, the amount of oil in the condensed water, delivered by the condenser after separation, had only eight parts of oil in it to the million parts of water by weight.

An analysis of the discharge from the separator showed that it had the balance of the oil fed to the engine with the exception of a small and neglible loss due doubtless to adhesion of oil to metallic surfaces which the steam, by its motion, could not remove.

The second test with twice the weight of oil fed to the engine, gave the same result or proportion of oil in the condensed water, indicating that the increased feed of oil did not make any difference in the effectiveness of the separation by the separator.

It will be understood, of course, that this test was directed solely to determine the effectiveness of the separator with regard to the condensed water and lasted only as long as the capacity of the oil cup on the cylinder supplied oil. It does not cover any other than this one detail.

Respectfully,

F. R. HUTTON

Society News

American Order of Steam Engineers

The Coming Convention.

Out in Pittsburg, the members of Iron City Council are exerting every effort to make the coming convention of the American Order of Steam Engineers, to be held there on May 11th, a decided success. Everything is being done to add to the comfort and convenience of the delegates and their friends.

In addition to the routine affairs of the convention there will also be an exhibition of steam specialties and engineer's supplies. This will also be held in the Victoria, in an admirable room for the purpose on the second floor.

This room has excellent light and ample floor space for a large exhibit. Those wishing to secure space should apply at once to F. C. Rose, 10 Federal St., Pittsburg, Pa.

Thus it will be seen that every detail of the convention will be held under one roof, which should insure a pleasant time for all who attend.

HOTEL VICTORIA, Sixth St. and Penna. Ave., Pittsburg, Pa.
Where the headquarters for the Convention of the A. O. S. E., commencing May 11th, will be.

All executive sessions of the Supreme Council will be held in the Hotel Victoria, where a large assembly room has been secured for the purpose. This same hotel will also be headquarters for all delegates and others attending the convention, all of which will make it very convenient, especially in case of bad weather.

Delaware Council

Delaware Council, No. 1, of Wilmington, held an open meeting on Wednesday evening, April 23d. There was a large attendance of members and local engineers and friends present, as well as a goodly crowd of visiting brothers from Philadelphia and Chester. There was an abundance of refreshments and good cigars, as is usual when Delaware Council celebrates, and there were interesting talks by Supreme Chief Williams and others. Brothers Mithell and Stay ton promised to be on hand at the com ing convention in Pittsburg.

Mr. John E. Codman, M. E., delivered a lecture, illustrated with stereoptican views, describing the new High Pressure Fire System of Philadelphia, before Southwark Council, on Monday evening, April 27th. The lecture was greatly appreciated by all present.

All roads lead to Pittsburg.

A great city; make it a great convention.

We understand that the Baltimore delegation has chartered a parlor car, and that Harry McGee is to be the conductor, and Stallings Sergeant at arms. Ding, Ding; go ahead, Sergeant.

Al. Diedrich will wear a high hat, and Pearson will wear a smile.

They tells us that Joe Harris is studying up a speech in which he will describe Milwaukee's many attractive features as a Convention City.

Obituary

James E. Deas.

Many of the older members of the A. O. S. E. will learn with regret of the death of James E. Deas, of Bridgeport, Conn. Mr. Deas was formerly an earnest and active worker in the order, and held the office of Supreme Treasurer for several years. He had many devoted friends in the order. Mr. Deas died at his home in Stepney, on Wednesday, April 15, aged 72 years.

Benjiman F. Pettit.

Few men have been more closely identified with the affairs of the A. O. of S. E. in years gone by than Benj. F. Pettit, who died at his home in Philadelphia, on Wedensday, April 8th. Mr. Pettit was an aggressive worker and organized quite a number of the first Councils of the order. He was at one time Grand Chief of Pennsylvania, and became a Past Supreme Chief.

TRADE NOTES

ANNOUNCEMENT.

We announce to our patrons and the trade that the undersigned company, duly incorporated under the laws of the State of Pennsylvania, have taken over the business heretofore known as James Bonar & Co., Pittsburg, Pa.

We will continue to manufacture and handle a full line of first-class Steam Appliances, adding a number of appliances from time to time necessary to make our line the most complete in this part of the country.

We are now erecting a first-class Machine Shop and Brass Foundry on our own property at 40th Street and A. V. R. R. This shop is for the purpose of manufacturing our own specialties and other machine work which we now solicit.

The machinery will be new and of the most modern design, and will be specially adapted to the manufacturing of special work.

In addition to this, the shop will be equipped with a modern steam plant, in which is included a special high pressure boiler for testing purposes. In the past we have felt the need of such facilities for testing high pressure work. We will therefore be in a position to accept the manufacturing of special work to be used in high pressure, making and testing it complete under actual condition before leaving our works.

Our Brass Foundry will be equipped with the most modern outfit in keeping with the other machinery.

One of our own specialties is the Bonar Oil Filter, which we will manufacture in our works, and in line with this solicit Galvanized Iron Work from the trade.—JAMES BONAR & CO., INC.

In the average manufacturing and power plants there is no item of exepense and danger so great, relatively speaking, as is the permission of the formation of scale in the boilers. We say permission, as there are some proprietors and managers who do permit scale to accumulate in their boilers, because they are so short-sighted as to only see the amount of the boiler compound bill, losing sight of the benefits to be derived from the use of an honest, intelligently prepared water purifier in the increased efficiency and life of their boilers and the decreased consumption of coal.

It is a proven fact, both theoretically and practically, that boilers can and are kept clean by the use of chemicals opposite or antagonistic to the scale forming properties with which most waters are impregnated. These properties are of vastly different qualities and quantities in different locations and waters, and as these quantities and qualities are positively determined by expert chemists, the preparation and mixing of antidotes is equally positive. The same is true of waters that pit the boilers, its cure is just as sure.

These being facts, the only sure way of neutralizing the scale forming properties of a water is to make analysis of the water itself, put together the proper kinds and proportions of chemical opposites and to then prescribe quantity necessary to produce a neutral water. This is the method pursued in the marketing of the Champion Boiler Compound, and for further information we refer you to the Acme Chemical Co., 123 South Delaware Ave., Philadelphia.

No modern power plant or engine room is complete without a medium for the filtration of of lubricating oil recovered or collected after first use. No matter how insignificant the amount of oil used in a plant, the cost and saving is worth consideration. With an oil consumption say of only six barrels per year a saving of 80 per cent. is a material advantage, and, in almost any section of the country, sufficient to more than pay for the small cost of the filter. Devices for filiering oil, no matter how poor and troublesome, are being installed every day, the accepted theory being that any form of filtration is better than none. A small illustrated booklet, describing the Capilar Oil Filter and the principle of "capillary action," has just been issued by The Capilar Company, 136 and 138 South 4th St., Philadelphia. A copy will be mailed free to any one mentioning THE PRACTICAL ENGINEER.

The combined work of Messers. John J. Sproul and W. J. Greenhough, of the Keystone Elevator Inspection and Repair Co., 923 Locust St., Philadelphia,is receiving the well merited patronage of their old friends among leading engineers and superintendents who appreciate good practical relief for their elevator troubles. Their new plant is equipped with the latest and most approved tools and appliances for the execution of elevator construction and repair work, of every variety, and they carry a full line of parts always in stock, which enables them to render the quickest possible service in case of breakdowns. Their shops and offices are centrally located, and they have both 'phones,' so that engineers in Philadelphia or vicinity can reach them with the least possible delay.

Owing to the rapidly increasing demand for Keystone Grease for high grade lubrication, the Keystone Lubricating Co., have found it necessary to open an office in New York City. The new office is located at Room 205, Postal Telegraph Building, 253 Broadway, and is in charge of Mr. Lewis E. Hopper, a bright and entertaining young man, who will doubtlesse prove a favorite with the engineers of the metropolis, Mr. Hopper offers to furnish a sample can of his grease and a Keystone Brass Cup free of charge for trial to any engineer in New York or vicinity. Those wishing to test his goods for themselves should drop him a card.

The Wright Manufacturing Company, of Detroit, Mich., makers of the "Emergency" steam trap, recently received the following letter from Chief Engineer Murray, of the Potomac Hotel Company, of Washington, D. C.: "I wish to state I am in every way pleased with your No. 4 Emergency trap. It has been in use in "The Richmond" since September last and has been handling the condensation from the entire heating system of house, and doing it in good shape, too. It displaced two large traps, either of which occupied a third more space than the Emergency, and is doing more work and better work. I should not hesitate in future, should I require a steam trap, but order at once an "Emergency."

An attractive circular has been issued by The Heilman James Co., 404 Frick Building, Pittsburg, Pa., describing Plastic Metallic Packing. This new packing represents a radical departure from the old style of soft packing or standard metalic packing, which are specially made for each case. It is put up in bulk and can be applied to any sized rod or any style of stuffing box. The Company recommend it very highly and guarantee satisfaction or no pay. A copy of the circular mentioned will be sent to readers of THE PRACTICAL ENGINEER upon request.

To throw away a valve just because it shows a disposition to leak is often useless extravagance. Many a valve has gone into the scrap when reseating would have made it as good as new. The Standard Valve Reseating Machine does not cost much, and even where a comparatively small number of valves are used it will soon save its cost. For catalogue and prices write to W. P. Barnum, 41 Newton St., Fredonia, N. Y.

Berry's Boiler Feed Control is a safety alarm column and a perfect boiler feed regulator, which is simple of construction, but with a perfect, positive action. Its cost is so low that no boiler should be without one. It keeps the water between given points in the boiler, and adds a factor of safety which makes it well worth its cost. A catalogue will be sent to any one interested by The Berry Engineering Co., Chester, Pa.

IF ENGINEERS will send $1.00 to the address below they will receive two blue prints, with tables and instructions, showing how to set valves and eccentrics on Corliss engines, simple and compound, with one and two eccentrics. JOHN T. LINDSTROM, 214 and 216 S. 3d St., Allentown, Pa.

A BELT DRESSING WITHOUT A "WEAK SPOT"

Endorsed by over 8000 of the Largest Firms in the World

AS OTHERS SEE IT

THE PULLMAN COMPANY,
Chicago, Oct. 7th, 1902.

The Beltine Mfg. Co., City.
Gentlemen:—Referring to your letter of Oct. 3rd, relative to the Beltine furnished on order 659 P. C. W. 18, wish to advise that our people at Pullman report this material as being very satisfactory.
Yours truly, WM. A. ANGELL,
PURCHASING AGENT.

A trial will convince the most sceptical, and it is sent on approval. Write us

THE BELTINE MFG. CO.

53 and 55 West Jackson Blvd., CHICAGO

Eastern Agents Wanted

Brotherhood Overalls. The name means much and that is the kind of overalls that every man who understands them eaning of the word, should ask for. For in this case it means that the maker is a Brotherhood man in the highest sense—a member of organized labor and a man who practices its teachings in his daily life, especially in his business. His employees receive good pay and everything possible is done for their comfort. They look healthy and happy and in striking contrast to the workers in sweat shop overall factories. That is one reason why you should insist upon having Brotherhood Overalls. The other reason is because they are better.

Agent Wanted. Fred L. Bickel, 1348 Palmer St., Philadelphia, wants good men to act as agents for his steam traps. These traps have some features worth investigating. Mr. Bickel will be pleased to furnish further details to persons mentioning this "Journal."

The "P. B. H." Quick Closing Water Gauge has saved many a burnt hand and often prevented all the water from blowing out of the boiler. Their advantages are so numerous and their cost so trifling that no boiler room should be without them. They are manufactured by Paul B. Huyette, 1245 Betz Bldg., Philadelphia.

Chas. S. Solomon Co., 920-22 Sansom St., Philadelphia, are now comfortably settled in their new shops, and with a full equipment of the most modern machinery and tools and a corps of first class mechanics, are prepared to do high grade machinery and engine repair work at short notice. They also build special machinery to order.

A handsomely printed catalogue descrlbing the Vigilant Feed Water Regulator has been issued by the Chaplin-Fulton Mfg., Co., Pittsburg, Pa. Copies will be sent upon request to readers of THE PRACTICAL ENGINEER.

To avoid the ordinary little troubles engineers frequently have with elevators, write or phone for a handy little booklet, issued for gratuitous distribution by the Keystone Elevator Inspection and Repair Co., 923 Locust St., Philadelphia.

The Sims Co., of Erie, Pa., report that K. Lund & Co., of Christiana, Norway, after having given their "Sims" Low Water Alarm a thorough test and trial, have placed their order with them for twelve of these devices."

"Get your money's worth" is a popular song that might be profitably sung to many a steam user, for few of them get their money's worth out of coal. Those having water tube boilers could get a great deal more out of their coal if they would keep the tube clean. This can be done with very little expense or labor by using the cleaners manufactured by the Liberty Mfg. Co., 5988 Centre Ave., Pittsburg, Pa.

The General Engineering Co., 764 Swanson St., Philadelphia, have recently added a large number of new tools and machinery to their already well equipped shops. Among their new tools are included boring bars for reboring cylinders in position and other special tools for facilitating quick and perfect work.

Those interested in steam and oil separators and steam traps, will do well to write for the new catalogue just issued by John T. Lindstrom. The catalogue is intended to give a clear insight to the construction and value of these devices, and it will prove of practical value to either operators or engineers. A postal addressed to John T. Lindstrom, Allentown, Pa., with mention of this paper, will secure it.

THE MAN WHO PAYS THE BILLS

has a vital interest in making them as small as possible. Your oil bill is probably twice what it should be. Anyhow, we will make a positive guarantee that we can reduce it 50 per cent. by the use of a

CROSS OIL FILTER

It reclaims and purifies the lubricating oil you are throwing away as useless. By using this oil over and over again you can make the Filter pay for itself quickly.

We will send the Filter on 30 days trial. If it doesn't cut your oil bills down one-half there's nothing to pay.

"We have been using one of your Oil Filters for the past two seasons, and it has reduced our lubricating bill a little over 55 per cent."

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Can you afford to wait? We think not.

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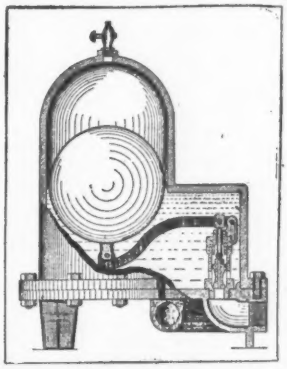

The "FORD" Compound Steam Trap

We want you to take hold of it. Made in 5 sizes. Has large outlet and the largest capacity of any Steam Trap on the market.

Write for full particulars and prices.

Thomas P. Ford Co.

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The most useful article that can be used about any engine room or power plant is Dixon's Pure Flake Graphite, which either alone or in combination with grease or oil makes the most perfect lubricant known. The tests of experts and the testimony of practical users all point to exactly the same thing.

Ask for booklet 96-c.

Joseph Dixon Crucible Company, Jersey City, N. J.

EASY TO CLEAN

In a COCHRANE HEATER every facility is provided for easy, rapid and thorough cleaning. There are surface and settlement blowoffs for use during a run, while for a complete cleaning there are large, well-placed man and hand holes, removable trays and a filtering bed that is the easiest thing in the world to get at. All the work can be done with a hoe and a hose. The time required is a matter of minutes. An engineer can clean a Cochrane Heater and have it ready to start up in from half an hour to an hour and a half, according to the size of the heater and the badness of the water. Every detail of design and construction has received most careful attention in the Cochrane Feed-Water Heaters, for while heating and purification come first, there are many little points that an engineer likes to have just right—and these *are* right in the Cochrane Heaters.

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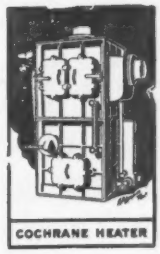
Manufacturers of Cochrane Steam and Oil Separators.



COCHRANE HEATER

American Order of Steam Engineers.

ORGANIZED APRIL 27, 1886.

An Order of Engineesr for Engineers and Engineers only.

DECLARATIONS OF PRINCIPLES

Believing that ability will bring its full value in this country, this Order shall at no time take part in strikes, nor in any way interfere between employer and employees. Recognizing their identity of interests, it shall take no part in any project or enterprise that shall interfere with perfect harmony between them ; neither shall it be used for political or religious purposes.

These principles shall not be amended or repealed except by unanimous vote of the Order.

Any member who shall be guilty of violating the principles of the Order shall be expelled.

OBJECTS.

First.—To promote a more thorough knowledge in its members of theoretical and practical steam engineering.

Second.—To assist members to obtain employment.

Third.—To help the sick, injured and distressed and bury the dead.

Fourth.–To establish a Widows' and Orphans' Fund.

Fifth.—To help members who shall become incapacitated from following the profession to obtain employment suited to their affliction.

Sixth.—To do our utmost to extend the license law throughout the United States.

Seventh.—To establish schools in which our members may study the highest branches of steam engineering.

MEMBERSHIP.

An applicant for membership must be an engineer between twenty-one and fifty years of age, and must be a white male citizen of the United States, of good moral character and be a believer in the Supreme Being, and be free from all physical infirmities.

He must have had three years' service in an engineering department, or if a machinist, or graduate of a technical institute, then one year's service, in such department, and in localities where engineers are required by law to be licensed, they must have such license, and must satisfy the investigating and examining committees of the council to which he applies as to his character and ability.

LIFE MEMBERSHIP.

Engineers who have passed the age limit may be admitted to life membership. They must possess the same qualifications and pass the same examination as are required in the next proceeding clause: They shall be entitled to all rights and privileges of the Order except they cannot vote on financial questions or for the election of officers or be entitled to any sick or death benefits.

DIRECTORY.

The Publication Committee of "The Practical Engineer" desires that the Corresponding Engineers of all Councils of the American Order of Steam Engineers send the name of their Chief Engineer and their own name and address, together with the time and place of meeting, to the Secretary of the Publication Committee immediately after each election of officers. Address J. C. McDowell, Secretary, in care of "The Practical Engineer," 1215 Filbert Street, Philadelphia.

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Delaware Council, No. 1, meets every Wednesday at S. E. Cor. Fourth and King Sts. Chief Engineer, Harry W. Sherman. Corresponding Engineer, A. E. Deakyne, 406 Lombard St.

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JENNINGS.

Jennings Council, No. 2, meets every Saturday evening in American Bank. Chief Engineer, Daniel R. Jones. Corresponding Engineer, R. E. Funk.

MARYLAND.

Deputy Supreme Chief Engineer, A. J. Deidrich, 226 North Caroline St., Baltimore, Md.

BALTIMORE.

Maryland Council, No. 1, meets 2nd and 4th Fridays in Royal Arcanium Hall. Chief Engineer, Geo. Goodwin. Corresponding Engineer, Wm. S. Smith, 533 Sharp St., Baltimore.

Energy Council, No. 2, meets every Wednesday of each month in Bauer Hall, Chesapeake and Elliott Sts. Chief Engineer, T. E. Eaton. Corresponding Engineer, Thos. O. Daneker, 834 East Ave.

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Deputy Supreme Chief for Eastern District, W. E. Packard, Whitmann.

BOSTON.

Boston Council, No. 4, meets 2nd and 4th Thursdays of each month, in Templar Hall, 724 Washington St. Chief Engineer, A. R. Abbott. Corresponding Engineer, Phillip Sanford.

ROCKLAND.

Old Colony Council, No. 14, meets 2nd and 4th Saturdays in the American Foresters' Hall. Chief Engineer, Herbert W. Jones. Corresponding Engineer, James K. Sedgwick, Box 333, Rockland, Mass.

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Deputy Supreme Chief, F. O. Garrison, Bridgeton, N. J.

PERTH AMBOY.

Stevens Council, No. 1, meets 3rd Saturday, at Water, near Lafayette St. Chief Engineer, Lawrence Oliver. Corresponding Engineer, James H. White.

CAMDEN.

Camden Council, No. 3, meets every Thursday evening at N. E. Cor. Second and Federal Sts. Chief Engineer, C. H. Harigle. Corresponding Engineer, C. H. Pfeiffer, 571 Berkley St.

ATLANTIC CITY.

Atlantic City, No. 4, meets every Tuesday evening at Merchants, Cor. Atlantic and New York Aves. Chief Engineer, Wm. Fowden. Corresponding Engineer, W. S. Price, Haddon Hall.

BRIDGETON.

Bridgeton Council, No. 5, meets every Friday. Chief Engineer, David Sellers. Corresponding Engineer, Francis O. Garrison, Bridgeton, N. J.

MILLVILLE.

Millville Council, No. 6, meets every Saturday, 7.30 P. M., in G. A. R. Hall, East Main St. Chief Engineer, Geo. Esabel. Corresponding Engineer, Lewis Doughty, 604 Mulberry St.

NEW YORK.

SYRACUSE.

John E. Sweet Council, No. 6, meets Monday, Room 23, Nottingham Block, East Washington St. Chief Engineer, John Cunningham. Corresponding Engineer, S. A. Steel, 311 Orange St.

PENNSYLVANIA.

Grand Chief Engineer, Hiram Trout, 1042 Locust St., Reading, Pa. Deputy Grand Chief for Philadelphia and Delaware Counties, John P. Rickards, 2707 N. Broad St., Philadelphia. Grand Corresponding Engineer, Frederick Markoe, 931 Orianna St., Philadelphia.

Deputy Grand Chief for Western Pennsylvania, A. D. Hamilton, 2025 Forbes St., Pittsburg, Pa.

PHILADELPHIA.

Germantown Council, No. 22, meets every Wednesday evening at Main and Seymour Sts., Germantown. Chief Engineer, L. F. Souders. Corresponding Engineer, Frank MacIndoe, 3529 Ainslie St., Falls of Schuylkill, Philadelphia.

Welcome Council, No. 2, meets every Friday, N. W. Cor. Twelfth St. and Columbia Ave. Chief Engineer, Paul Pieling. Corresponding Engineer, L. D. Woodington, 2428 N. Bancroft St.

Kensington Council, No. 3, meets every Thursday, at A. P. A. Hall, Frankford Ave. and Master St. Chief Engineer, C. W. Leng. Corresponding Engineer, Ernest Ritsert, 2229 Frankford Ave., Philadelphia.

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TRADE MARK
TRI-SODIUM PHOSPHATE
INCREASED BOILER EFFICIENCY
DECREASE IN THE FUEL BILL
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This and a lot more about its prolonging the life of the boilers, is the story its users have to tell. Would you like to know what it would cost to keep your boilers clean? Send us a gallon of your feed water, the analysis free. So is our Booklet "WORTH KNOWING."
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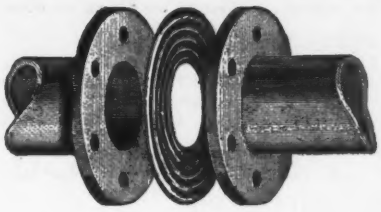

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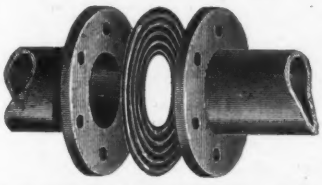

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illustrated here is designed for Single Engines or Large Plants where many Engines are operated from one steam main. It will oil one or a dozen Engines, save 40 per cent. of Oil used with any other Lubricator, and prevent annoying leaks in Steam Pipes.

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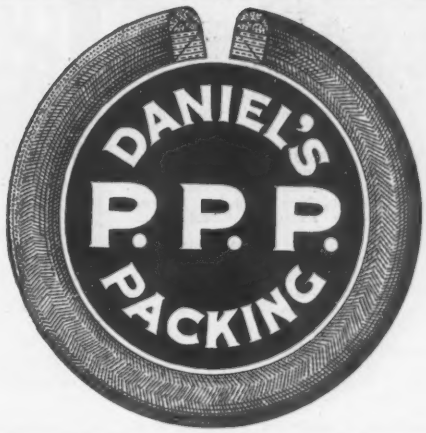

A Wise Man

There was a man in our town,
And he was wondrous wise.
He packed his rods with "P. P. P.",
And much to his surprise
The engine ran for months and months,
Once packing was enough,
And coal was saved until he cried:
"Well, P. P. P.'s the stuff."

An enormous waste is loss of power from solid packing. Your competitors have stopped this waste by using

DANIEL'S "P. P. P." PACKING

Instead of holding the rod in a tight grip as solid packings do, the sliding wedges of P. P. P. adjust themselves to the rod with the least possible pressure. What it saves in fuel is told by Mr. Geo. T. Gilbert, Chief Engineer for Forbes & Wallace, Springfield, Mass., who says:

"In a carefully conducted test, covering a long period of time, it showed a saving in my coal bill of $104.95 per annum, on one 12½x12 inch engine, which is due to reduced friction on the rod."

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FREE—Our patent steel packing rule saves engineers' labor, time, trouble, temper, packing, burnt fingers and swear words. It is worth $1.00. Sent absolutely FREE to engineers who order from us enough "P. P. P." for a trial, if they mention this paper.

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Southwark Council, No. 4, meets every Monday, at Cor. of Reed and Eighth Sts. Chief Engineer, Joseph Hynes. Corresponding Engineer, J. C. McDowell, 1913 South Eighth St.

Philadelphia Council, No. 7, meets every Wednesday, at Kenny's Hall, N. W. Cor. Broad and Filbert Sts. Chief Engineer, W. G. Richards. Corresponding Engineer, W. S. Wetzler, 3717 Aspen St.

Manayunk Council, No. 9, meets 2nd and 4th Friday evenings in Temperance Hall. Chief Engineer, John Hill. Corresponding Engineer, John Clevenger, 211 Lofty St.

Helping Hand Council, No. 12, meets every Thursday evening at Kensington Ave. and C St. Chief Engineer, Edward Laurence. Corresponding Engineer, Frank McHugh, 2503 Tulip St. All correspondence should be addressed direct to the Council.

Municipal P. F. D. Council, No. 20, of Philadelphia, meets the second Thursday of each month at Odd Fellows' Hall, Third and Brown Sts. Chief Engineer, Daniel Bunting. Corresponding Engineer, Walter Meyers, 1211 North Howard St.

PITTSBURG.

Iron City Council, No. 21, meets every Saturday at Arnfeld Hall, 1119 Penn Ave. Chief Engineer, J. J. Stewart. Corresponding Engineer, Alex. Fraser, Carnegie, Pa.

GIRARDVILLE.

Girard Council, No. 8, meets every Tuesday evening at O'Neill's Hall, Second and Ogden Sts. Chief Engineer, Jacob Weber. Corresponding Engineer, M. J. Carey, Lock Box 214.

ALLENTOWN.

Lehigh Council, No. 15, meets every Wednesday evening at 639 Hamilton St. Chief Engineer, John Durrin. Corresponding Engineer, A. P. Driesbach, 728 Chew St.

POTTSTOWN.

Pottstown Council, No. 14, meets 1st and 3rd Saturday evenings at P. O. S. of A. Hall, Cor. High and Hanover Sts. Chief Engineer, Wm. Rickert. Corresponding Engineer, H. L. Shirey, 362 Cherry St.

READING.

Progress Council, No. 13, meets every Saturday evening at Diebert Hall, Ninth and Penn Sts., Room 4. Chief Engineer, A. B. Hess. Corresponding Engineer, Frank S. Miller, 3 West Franklin St.

CHESTER.

Delaware County Council, No. 6, meets every Wednesday evening in the Carpenter Hall, Sixth and Wall Sts. Chief Engineer, John Canavan. Corresponding Engineer, E. E. McCoy, 2222 West Third St.

YORK.

York Council, No. 16, meets every Wednesday Evening in the Jordan Block. Chief Engineer, A. L. Bair. Corresponding Engineer, Walter H. Long, 23 East Philadelphia St.

HARRISBURG.

Capitol City Council, No. 17, meets every Tuesday evening in Red Men's Hall, Market St., above Second. Chief Engineer, B. H. Shafer. Corresponding Engineer, S. Filson, 1126 Market St.

COLUMBIA.

Columbia Council, No. 18, meets every 1st and 3rd Saturdays, in Odd Fellows' Hall. Chief Engineer, Amos Simmons. Corresponding Enginner, W. J. Courtney, 804 Walnut St.

SUNBURY.

Sunbury Council, No. 19, meets every Monday evening in Zartman's Hall. Chief Engineer, H. E. Culp. Corresponding Engineer, Ed. Schrieber.

WISCONSIN.

Deputy Supreme Chief Engineer, Joseph P. Harris, No. 1611 Clybourn St., Milwaukee.

MILWAUKEE.

Washington Council, No. 1, meets every Saturday at 207 Grand Ave. Chief Engineer, J. B. Chambers. Corresponding Engineer, James A. Rigby, 136 Reed St.

Clifford P. Williams Council, No. 2, meets every Monday evening at Lodge Hall, E. Water St. Chief Engineer, Elmer Towers. Corresponding Engineer, Joseph T. Harris, 1611 Clybourn St.

TENNESSEE.

Deputy Supreme Chief Engineer, John B. Mullen, 826 Central Ave., Nashville.

NASHVILLE.

Enterprise Council, No. 1, meets every Friday evening in the Twin Building on Cedar St. Chief Engineer, J. J. Johnson. Corresponding Engineer, Jno. B. Mullen. 209 Jackson Building.

OREGON.

Deputy Supreme Chief Engineer, Nat. Freese, Grant's Pass, Oregon.

GRANT'S PASS.

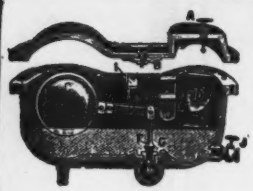
Oregon Council, No. 1, meets every 1st and 3rd Saturday in A. O. U. W. Hall, Main St. Chief Engineer, William H. Kenny. Corresponding Engineer, Nat Freese.

TEXAS.

Deputy Supreme Chief Engineer, S. A. Bisbey, care of Cotton Compress and Warehouse Co., Galveston.

GALVESTON.

Galveston Council, No. 1, meets every 2nd and 4th Tuesday evenings at Engineers' Hall, S. W. Cor. Twenty-second and Strand Sts. Chief Engineer, Max Levy. Corresponding Engineer, A. L. Bradford, Union Depot.



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Always have a Water Seal over the valve and never blow steam; neither do they back up water

REDUCING VALVES
EXHAUST PIPE HEADS,
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GREASE EXTRACTORS,
STEAM SEPARATORS, etc.

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CRANE VALVES
ESTABLISHED 1855

Steam Coal a Specialty

Telephone Connection 2-25-60

A. CRAWFORD COAL

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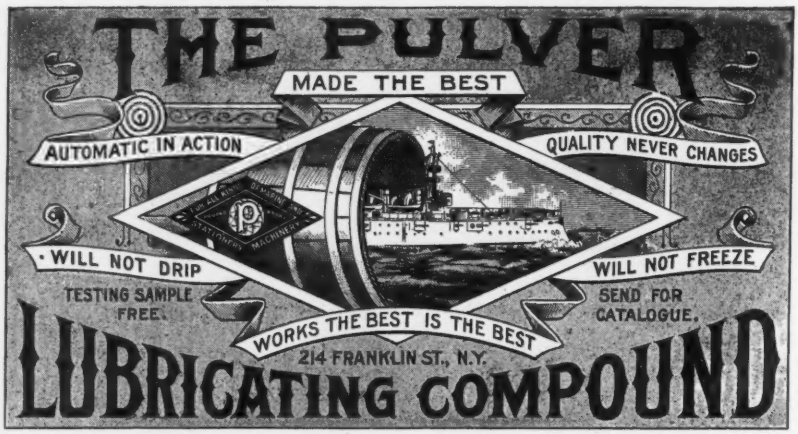

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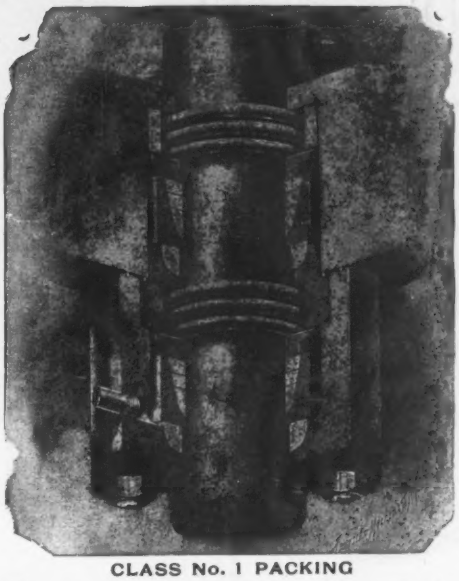

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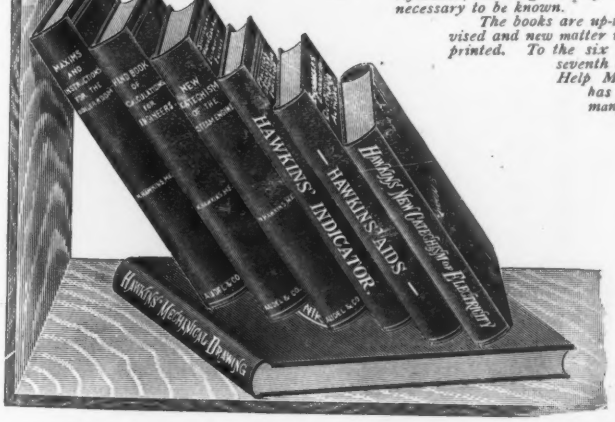

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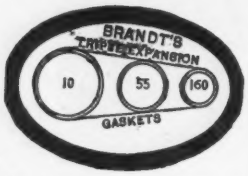

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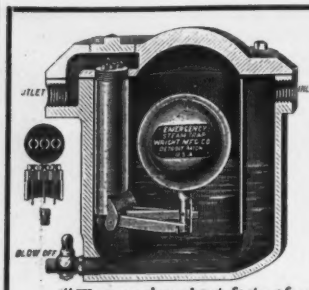

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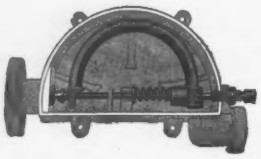

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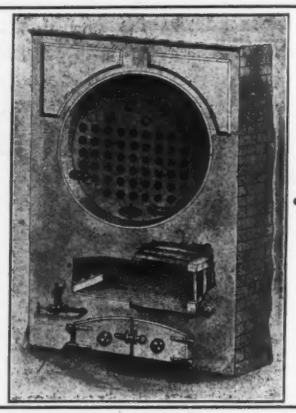

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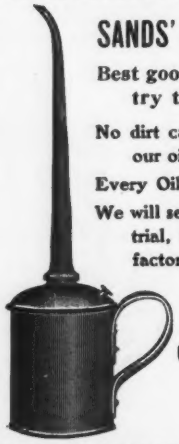

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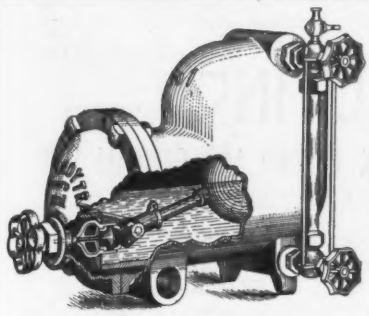

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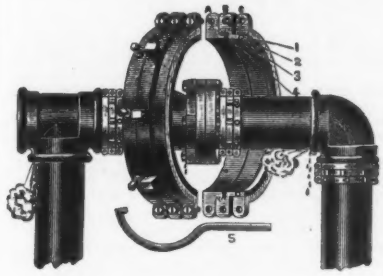

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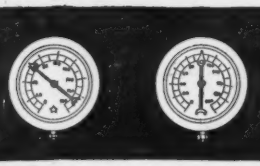

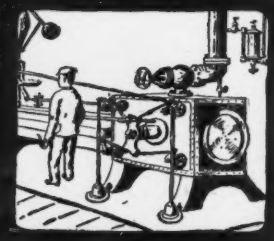

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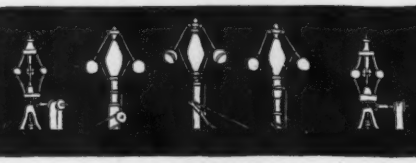

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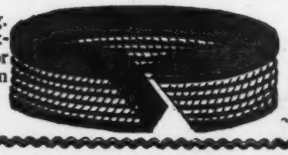

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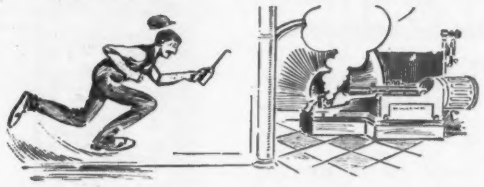

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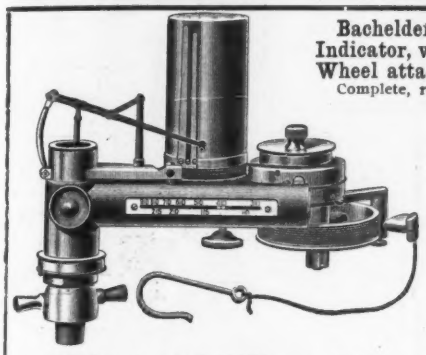

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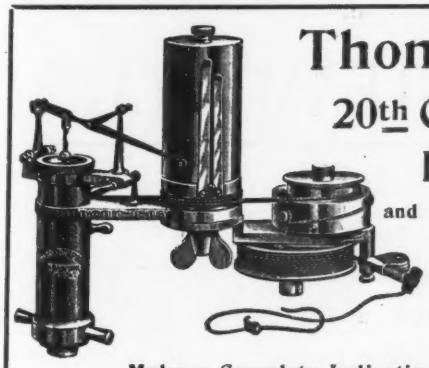

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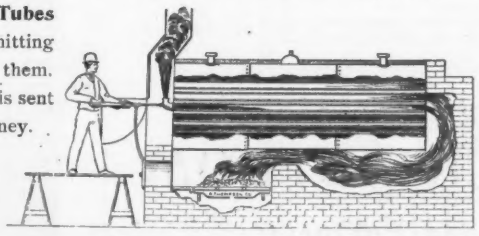

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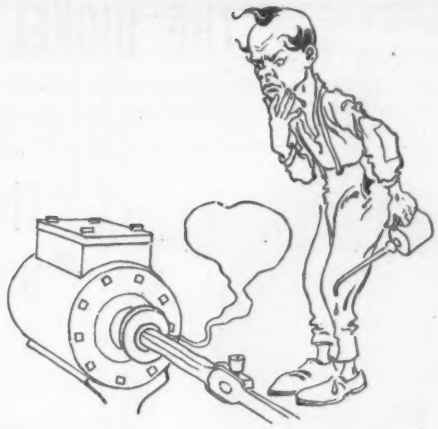

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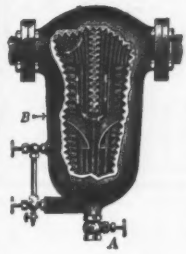

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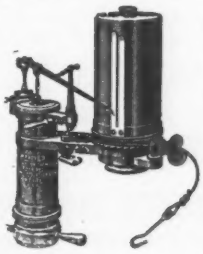

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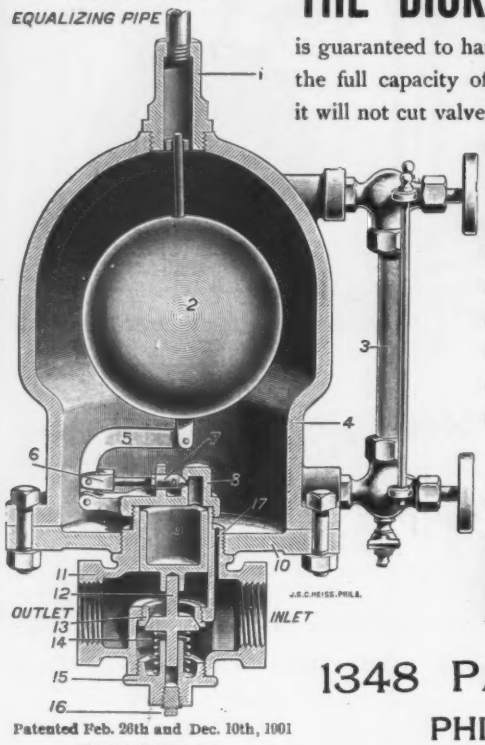

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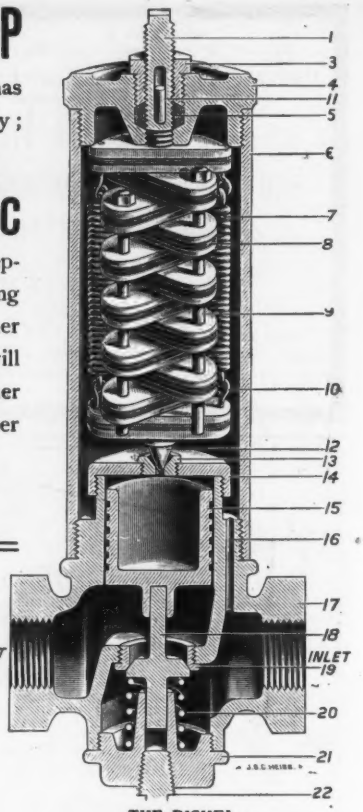

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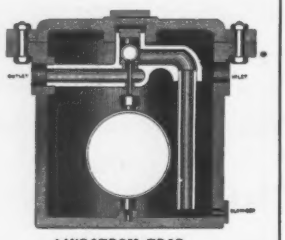

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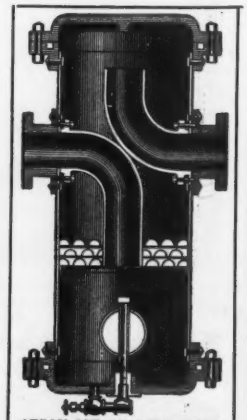

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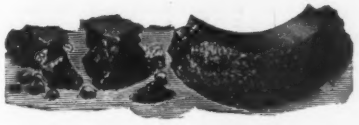

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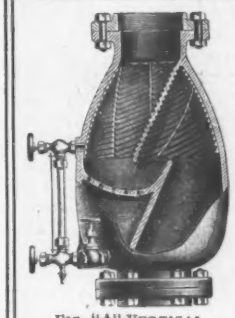

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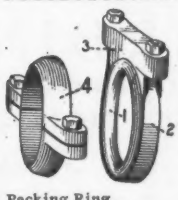

1 Packing Ring.
2 The Flexible Yoke.
3 Cross Head.
4 Split Collar, which keeps the packing in place.

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IF you have a leaky joint dripping water over valuable property, use one of **SMITH'S CLAMPS** and it will make a permanent repair.

It has no equal for simplicity, durability and low cost.

If your leak is in an inaccessible position, the use of our clamp will prevent having to tear out the piping. The illustration will tell the rest.

This Clamp is particularly adapted to close pipe connections, as it occupies less space than any other Pipe Clamp manufactured, and is cheaper, too.

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Miss Simplicity, the new name given the "Sims" Oil Filter by engineers who are using them.

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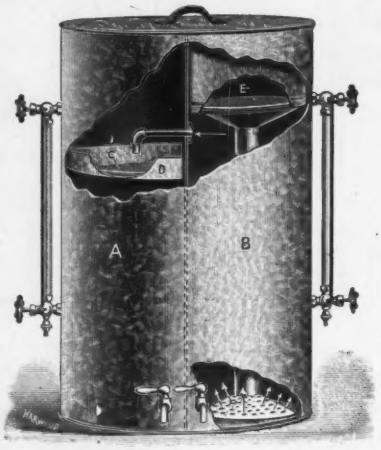
GENTLEMEN:—Referring to your inquiry, we take pleasure in saying that we have had a Sims Oil Filter in use in our Ice Works for some months.

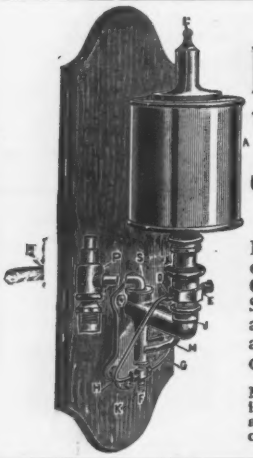
We had used three other filters prior to placing this one. We find that the "Sims" does better work than either of the others. The matter of cleaning is so small an affair that it is never neglected. The Filter has paid for itself many times since it has been in use.

Truly yours,
THE UNION ICE CO.



Write for Catalogue "E" and learn all about this Filter and the Steam Appliances we manufacture.

SIMS COMPANY, ERIE, PA.



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Brass Founders and Finishers and Makers of Pop Safety Valves, Water Relief Valves, Oil Cups and Lubricators, Steam Pressure Regulators and other safety steam appliances.

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WATER-TUBE AND STEAM-TUBE

Cast Iron or Steel Shells. "∩" Shaped Seamless Drawn Brass Tubes

WE BUILD HEATERS FOR EVERY PURPOSE AND CONDITION

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Improved Berryman Water Tube Feed Water Heater and Purifier

A thoroughly up-to date, reliable and efficient heater. Made to stand the highest pressure; and so constructed as to be utterly indestructible by the heaviest boiler it is possible to carry. Write for catalogue.

We have a few good heaters, second hand, which we will sell cheap, ranging from 50 H. P. to 1000 H. P. Mostly taken in trade for our Improved Berryman water tube Feed Water Heater and Purifier. Every heater is Tested and Guaranteed.

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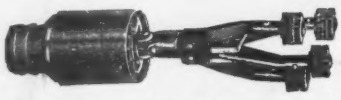

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IS THE ONLY PRACTICAL MACHINE FOR REMOVING SCALE FROM

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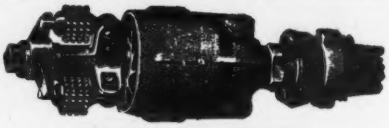

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THE PATENTS which we control cover all features essential to the design of a practical TURBINE TUBE CLEANER

We have suit for infringement pending against a user of the Lagonda or Weinland machine, and will prosecute all other INFRINGERS.

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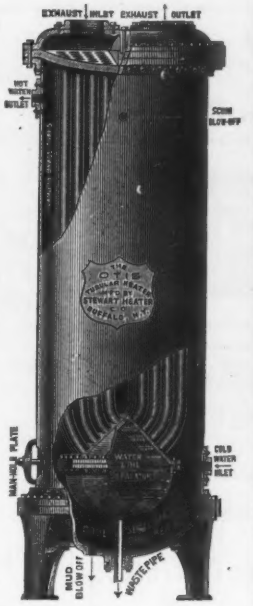
The OTIS Tubular Feed Water Heater, Oil Separator and Purifier

with Seamless Brass Tubes



Guaranteed

To heat the feed water to the boiling point (210 or 212 degrees) with the exhaust steam without causing any back pressure, **also to extract the oil from the exhaust,** so that the exhaust steam after being passed through the heater can be used for heating purposes, and the water of condensation for the heating system be returned to the boiler without the additional expense of an eliminator.

A Liberal Offer

If this heater fails to give satisfaction in every respect, we pay freight, cartage, etc., both ways.

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THE BERRYMAN HEATER AND THE HIGHEST
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FEED WATER PURIFIER GRADE ONLY AND SON
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PROVIDED WITH U SHAPED TUBES
IT NEVER LEAKS

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THE NATIONAL FEED WATER HEATER

1,100.000 Horse Power in Daily Use

Heats water to 210 degrees.
No inside joints to leak.
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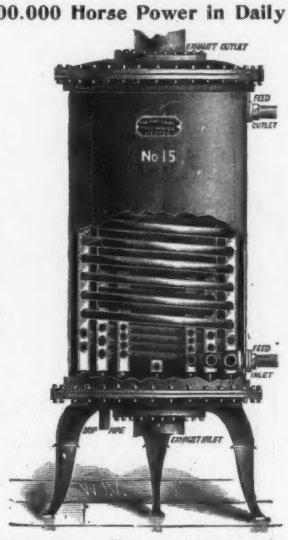
No chance for grease in boiler.



A heater noted for its Simplicity, Reliability, Effectiveness, Cheapness.

Heaters in use 20 years without repairs.
We manufacture the original and only genuine first class Coil Feed Water Heater.

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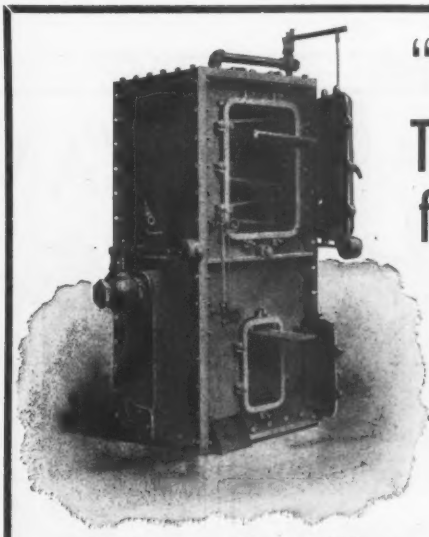

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This familiar saying describes one of the most important of the many advantages of

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The engine exhaust is not all passed through the heater, and thus only the steam necessary to heat the feed-water is used. The "no thoroughfare" feature is the cause of the great economy of these heaters. Write for our catalogue.

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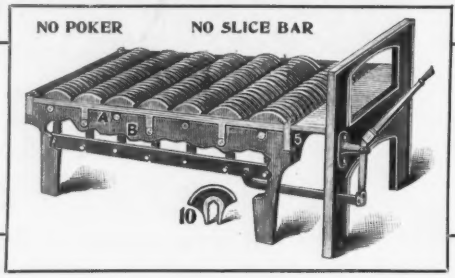

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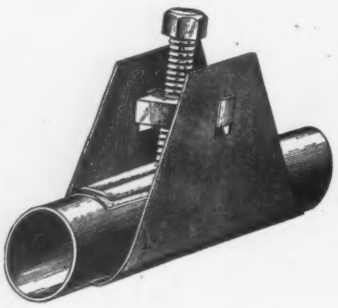

Effectually stops leaks in all kinds of steam and water pipes.

Easily adjusted, saves engineers worry and trouble.

Ask your jobber for them, or send to

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We also have the **Climax Steam Joint Clamp** for leaky steam joints.

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A Pull on the Chain Does it.
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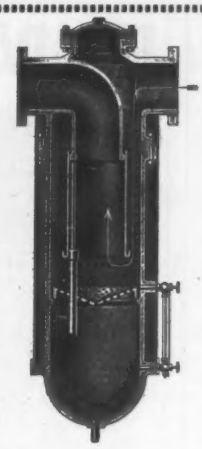

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Of little gutters are provided in **Sweet's Separator** for conducting the oil and water from the steam current and not a drop can get back. This is only one of many reasons why 50 per cent. of them are sold on duplicate orders.

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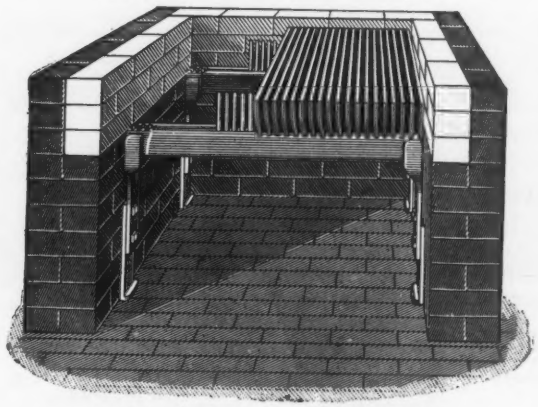

The Longest-lived Grate Bar That Ever Lived.

IMPROVED AMERICAN GRATE BARS

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THE ONLY GRATE WITH ADJUSTABLE FRAME.

THE ONLY GRATE WITH LOOSE TEETH BETWEEN THE BARS.

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The adjustable supporting frame, not coming in contact with the brick-work, saves the walls from getting loose, and can be adjusted to any height desired. The perforated supporting cross bar has less obstruction to a free circulation of air than any other Cross Bar made. The movable teeth between the Grate bars can easily be changed at any time, so as to give an air space between the bars that is desired to accommodate any size of fuel; the Movable Teeth also give the bars more freedom to expand and contract, thereby the bars are less liable to warp.

The American Grate Bars have given satisfaction where others have failed. Are made and for sale only by us; other parties have no right to make or sell them.

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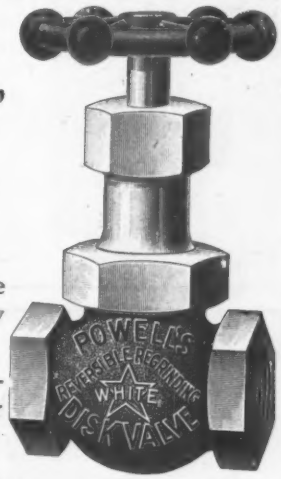

have a longer life and are easier to repair than any valve made.

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Requires LESS steam than any other cleaner.
Will positively clean BETTER than scraper or brush.
Will clean ANY length tube.
In operation is EQUALLY balanced, insuring NO back pressure against operator.
Is the LIGHTEST and EASIEST cleaner to handle.
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PUMPS Steam, Belt or Electric Power

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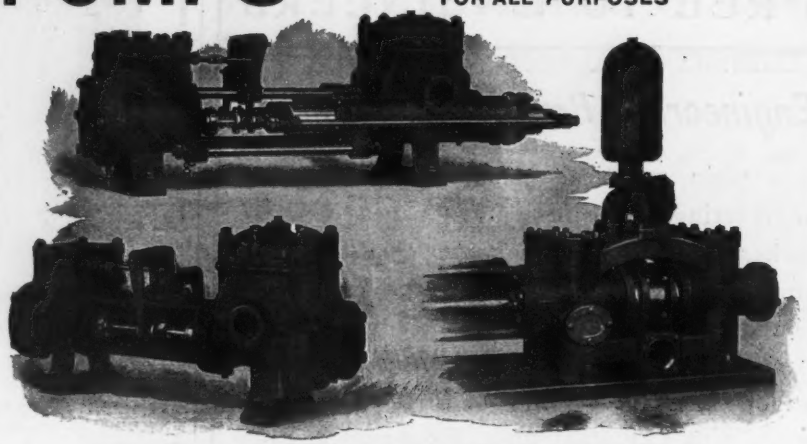

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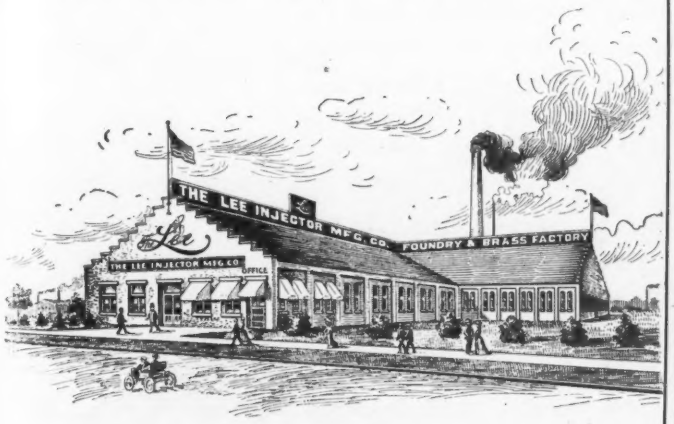

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Is Universally Recognized as the

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Simplicity of Construction.
It has but few working parts, all of which can be easily removed for cleaning, or can be replaced at slight expense when worn.

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Every Injector made by us receives a complete and careful test on actual boiler duty before being sent out, and can, therefore, always be depended upon to do its work where properly connected and operated.

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The jets in our Injectors are made of a special metal, very hard, and, therefore, they wear well under severe conditions.

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Lord's Water Purifying Chemicals

are guaranteed in every instance to do the work for which they are intended, i. e.: to purify the boiler feed water and to remove and prevent the formation of all incrustations or scale in the boiler.

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Send us a sample of the scale from your boiler—we make no charge for analysis, and we will give you a certificate showing results.

Send sample to

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Order a Standard Valve Reseating Machine

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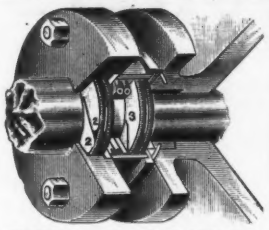

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Outside Type

It Holds Ammonia

without causing any friction, gives the engineer no trouble after once put on. Did you know that

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would do this? An engineer writes: "The same rods that are now working successfully cost us a good many hundred dollars last year in losses of oil, ammonia and cost of soft packing." Wouldn't you like to try it? Costs you nothing. We guarantee satisfaction or accept no pay.

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We are still at the old stand— able and willing to save you money.

Yours truly,
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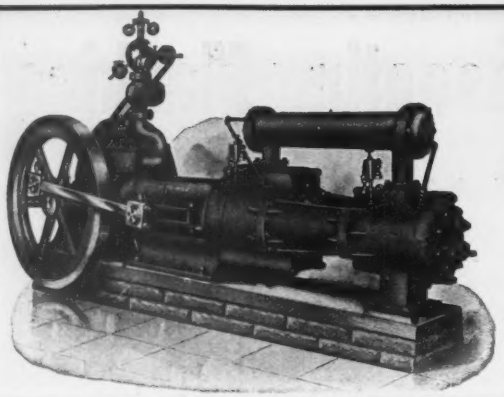

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Built in straight line and duplex types; Single and Multiple stage Compression; steam or belt driven. Very simple, durable, compact and efficient. Further particulars freely given. Address

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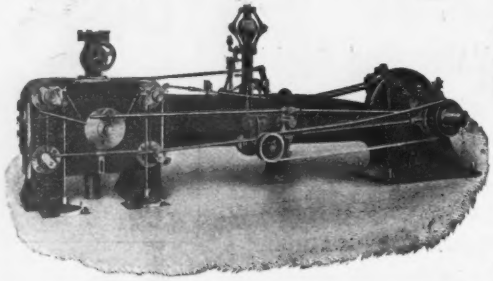

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CATALOGUES FOR THE ASKING

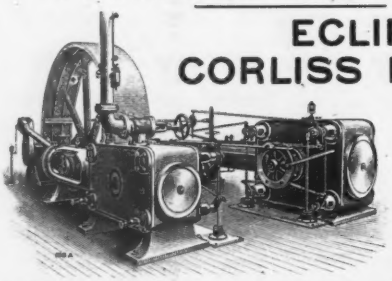
DEPT P.

Atlas Engine Works.
Indianapolis.

FRICK COMPANY

ENGINEERS

WAYNESBORO, FRANKLIN CO., PA.



ECLIPSE CORLISS ENGINES

Plain Corliss Engines, Cross and Tandem Compound, Vertical Corliss Engines.

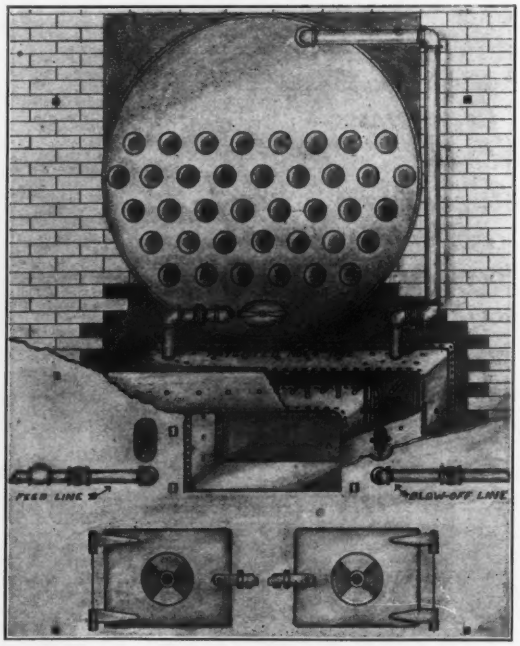
Corliss Engines of any type, 40 to 2 00 horse-power, specially adapted for electric railway work and lighting for factories, mills and general work. Best regulation and economy guaranteed. Also builders of Steam Boilers. We solicit the furnishing of steam plants complete, including everything. Send for our **Corliss Engine Pamphlet** and list of references.

ICE MAKING AND REFRIGERATING MACHINERY

We furnish complete plants for ice-making and refrigeration for Breweries, Packing Houses, Cold Storage, etc. All refrigerating capacities, from 2 to 300 tons; ice-making plants from 1 to 1000 tons per day. We publish a book describing Ice-Making and Refrigeration, which will be sent to intending purchasers.

NEW YORK OFFICE: Taylor Bldg, 39-41 Cortlandt St.

STEEL WATER ARCH



Saves the need of renewing brick arch; lasts as long as the boiler; increases capacity; does the work of a feed-water heater, and saves its cost in coal in a few weeks. You can't afford to be without it.

NEIL W. MAC INTOSH & CO. STEAM FITTERS
4 John Street - - - - NEW YORK

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Passenger and Freight Elevators

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PHILADELPHIA

AIR CUSHIONS, Automatic Car-Locking Devices, Mechanical and Electrical Indicators, Automatic Door Mechanism, Steam and Power Pumps, Electrical Annunciators, Safety Gates, Air Pumps, Air Tanks, Pressure Regulators, Etc.

Repairs and Alterations of Elevator Plants
A SPECIALTY

Bell Telephone 3-47-60 Keystone, Race, 1-47

ELEVATOR REPAIRS

MORSE, WILLIAMS & CO.

PHILADELPHIA

We have the largest and most complete Elevator Plant in Philadelphia, also a down-town storeroom, and skilled mechanics, especially for Repair Work.

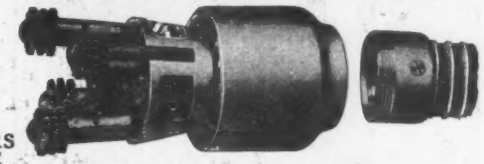
THE WEINLAND

WAS THE FIRST **WATER POWER TUBE CLEANER** EVER USED IN BOILER TUBES

THE RECORD PROVES IT. Mr. Weinland himself, a practical engineer, being the pioneer and first inventor in this line; and our Improved machines to-day are the natural outgrowth from our Original machine which contained the basic elements of all present day Turbine Cleaners.

¶ We do not imagine any one will be influenced by threats of suits made by our competitors, such intimidating methods, we think, are fully understood by all intelligent people and are condemned by all conservative fair minded business men.

WE SELL CLEANERS ON THEIR MERITS and will send them on approval with any kind of a written guarantee you may wish.



OURS ARE

EFFECTIVE, because a steady, constant cutting and grinding process is kept up at the proper point.

DURABLE, because parts are extra strong, no joints to work loose or wabble, and play around in tubes, injuring them and destroying cleaner.

ECONOMICAL, because they *save coal,* time, tubes and labor.

POPULAR, because they cost but little and do work upon which others fail.

Write us about anything connected with Boiler Cleaning. We're experts in that line. Had 20 years' experience and 'KNOW HOW."
All machines fully guaranteed and sent on trial.

THE LAGONDA MFG. CO.

SPRINGFIELD, OHIO

INVESTIGATE our "Lagonda" Feed Water Regulator

What!

Trouble with your Elevator?

Why? Try

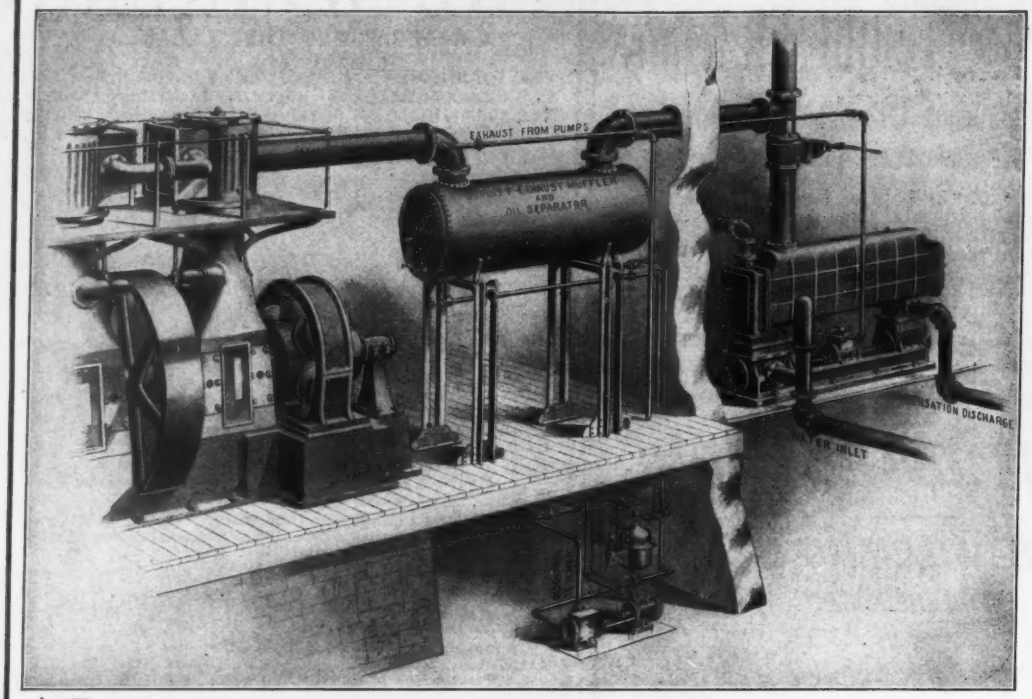
Keystone Elevator Inspection and Repair Co.

For all Classes of Repairs or New Elevators

Address, 923 Locust Street

'Phones { Keystone M 1006 / Bell 3-22-58

Philadelphia, Pa.



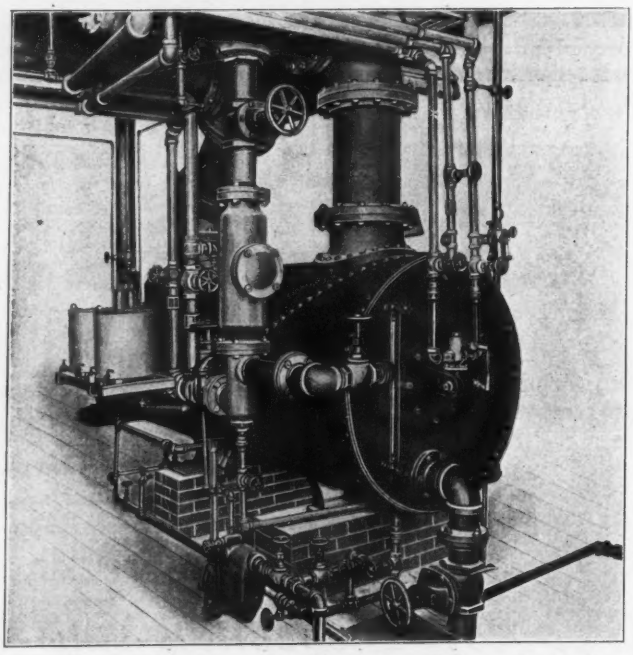
HOW IS THIS FOR A TEST OF OIL SEPARATION UNDER A VACUUM? SIZE No. 5 "UTILITY."

A TEST MADE BY F. R. HUTTON M. E., **Feeding Double** THE USUAL QUANTITY OF OIL, SHOWED AN EXTRACTION OF 99. 9992/10000%

Exhaust Muffler and Oil Separator as Installed in a Condensing Engine Plant.

We **GUARANTEE** the **"UTILITY"** the **BEST OIL SEPARATOR** on the market, either for condensing or non-condensing work, and it is **SELF-CLEANING**. Installed in your **MAIN** exhaust pipe we **GUARANTEE** you can return to your boilers all exhaust condensation and we will keep your boilers and heating system **ABSOLUTELY** free from **OIL**.

The **"UTILITY"** Feed Water Heater is simple in construction, requires no floor space, and heats the boiler water to 212 degrees.



Our **GUARANTEE** is based on the **CHEMICAL ANALYSIS** of the condensed exhaust steam **BEFORE** and **AFTER** passing through our device **WHICH IS POSITIVE PROOF.** We were the first on the market to show such a test and are always pleased to do it in any of the hundreds of **"UTILITY"** installations.

Send for booklet of testimonials. **Our customers talk for us.**

Our prices will interest you.

Exhaust Muffler, Oil Separator, Return Tank, Pump Governor and Feed Water Heater as Installed in a Non-Condensing Engine Plant.

THE STANDARD STEAM SPECIALTY CO.

Steam Specialties

542-544 West Broadway, CITY OF NEW YORK.

Take Hold

..of..

Keystone Grease

and test it for yourself

Clean some particular bearing that has caused you trouble, then apply KEYSTONE GREASE and watch results.

If all of your bearings are running easy, then test it alongside the grease or oil you now use, and see how much further KEYSTONE GREASE will go and how much better work it will do.

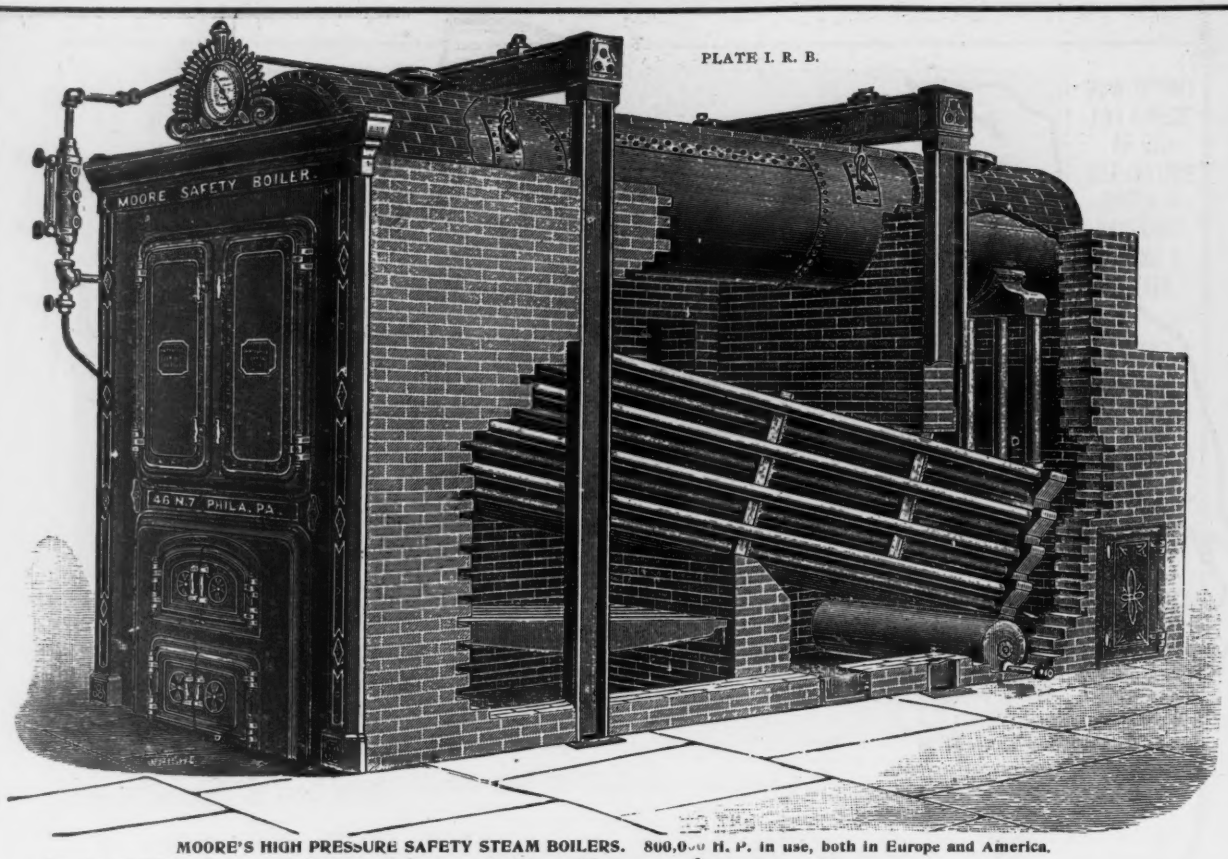
It will cost you absolutely nothing to try it, just send us your name, and by first express we'll send you a can of KEYSTONE GREASE and a HEAVY BRASS GREASE CUP to feed it with. FREE expressage paid.

Don't fail to send at once, to-day—you'll thank us later.

One pound of KEYSTONE GREASE will last longer and and do more than three to five pounds of any other grease made, or three to four gallons of the best lubricating oil.

Keystone Lubricating Company

Twentieth and Allegheny Avenues ✾ ✾ *PHILADELPHIA*



MOORE'S HIGH PRESSURE SAFETY STEAM BOILERS. 800,000 H. P. in use, both in Europe and America.

Repairs of Water Tubes. Boilers of all types a specialty. We have special tools for this purpose.
We keep constantly on hand ready for shipment 1000 horse-power. There can be no delay. **Send for Catalogue.**

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Gray-White, Semi-Steel Aluminum Alloy Castings. Mills and Pulverizers for Minerals, Cereals, &c.
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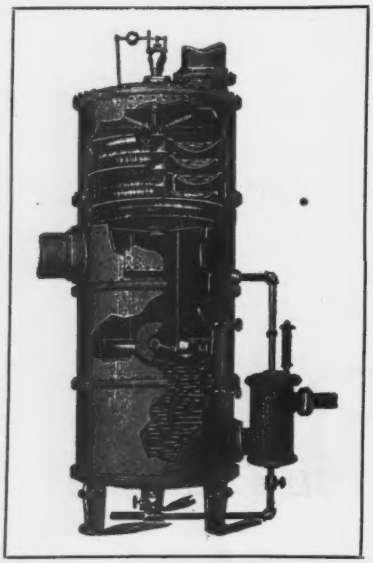

PITTSBURGH FEED WATER HEATER AND PURIFIER

This heater will accomplish all an exhaust heater can accomplish. It will save its cost in coal within a few months, and will furnish pure water to the boilers.

Ten years' experience has proven our method of separating the oil and other impurities from the feed water—to be correct; we positively take out all impurities that are precipitated, at a temperature of 210° to 212°.

ILLUSTRATED CATALOGUE SENT TO ANY ADDRESS

JAMES BONAR & CO., Inc.

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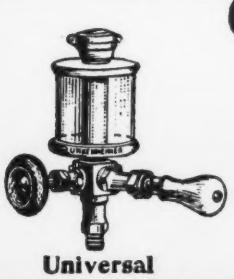

Universal

LUNKENHEIMER GLASS BODY OIL PUMPS

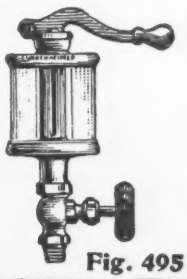

Fig. 495

Are easy to fill, attach and operate. Glass body shows stage of oil. Made in four sizes, holding ⅛, ½, 1 pint, 1 quart of oil. The "Universal" can be attached either vertically or horizontally by transposing a plug and shank which are interchangeable. Oil Pump Fig. 495 can only be attached vertically. Both styles are of handsome design and highly finished, and warranted to satisfy. Specify "LUNKENHEIMER" make and order from your dealer. Write for catalogue of Superior Brass and Iron Steam Specialties.

THE LUNKENHEIMER CO.

Sole Makers and Patentees, **CINCINNATI, OHIO, U. S. A.**

BRANCHES: New York, 26 Cortlandt St. London, 35 Great Dover St.

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Sales Agents for Philadelphia: FORD & KENDIG CO., Nos. 1428-1432 Callowhill Street.
Engineers are invited to call and inspect a full line of our goods.

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IMPORTANT NOTICE

We have rebuilt our large factory at Camden, N. J., since being burned out some time ago, and are now ready to supply our Nonpareil Cork Covering for steam, water and brine pipes.

Many of our customers knowing the value of cork as an insulator, have placed orders with us for Cork Covering, to be delivered when plant was rebuilt. If you contemplate purchasing pipe covering for any condition of service, you should find out about cork before placing your order.

JOHN R. LIVEZEY
1936 SANSOM STREET
PHILADELPHIA

The Nonpareil Cork Mfg. Co.
Gerken Building
Chambers St. and W. Broadway NEW YORK

1208 E St., N. W., Wash., D. C. Builders' Exchange, Pittsburg, Pa. 113 S. Gay St., Balto., Md.

'96 Jenkins Standard '96 Packing '96

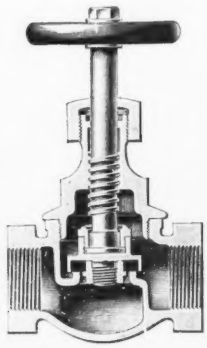
The Perfection of Joint Packing. Do not accept unless it bears our Trade-Mark as shown in the cut.

Use Jenkins '96 Sheet Packing on the worst joint you have, and if it is not what we claim we will refund the money.

JENKINS '96 PACKING has stood the most crucial tests under all conditions of service with steam, oils, acids, ammonia and the like, and in no case has it failed to make a perfect joint when properly applied. Can be placed in a joint either hot or cold, and will make joint instantly. Full steam pressure can be turned on at once when joint is made, it does not require to be followed up and will not blow out. It vulcanizes in place and forms a compound that will not rot or burn out, but will last as long as the metals which hold it. It joins with rough surfaces equally as well as when they are faced. **Jenkins Standard '96 Packing** weighs less than most joint packings. When compared with equal sizes of other packings sold at a lower price per pound, it will be found to cost less per square yard.

Jenkins Brothers' Valves

Designs, workmanship and materials of the highest standard throughout. Every valve inspected and tested before leaving the factory. Made in all styles and sizes, both brass and iron.



Jenkins Discs

Do not be deceived when you are offered discs "just as good" or better than the Jenkins, as many worthless imitations of our discs are on the market. We are the original manufacturers of this class of goods, and we have tried to maintain the high standard in which they are held by steam users throughout the world. Copper, Lead, Babbitt and all kinds of metal discs have been experimented with for the past twenty years, and in almost every instance, when under the action of steam, they become oxidized and hard, so that chip or scale getting between the disc and seat causes a leak, which necessitates regrinding. Insist on having the genuine Jenkins Discs; the difference in cost will not pay you to experiment. If you wish discs for any particular purpose, write to us; we can experiment cheaper for you than you can for yourselves. **Jenkins Discs will stand steam, oils or acids. We have special soft discs for cold water.**

Jenkins Brothers' Pump Valves

Adapted to every pumping requirement, these valves are especially suited for pumping hot water, syrups, beer and other destructive fluids; also muddy and gritty water. When rubber valves have been found useless, these valves have given entire satisfaction.

For mining and high-pressure service, also for elevator pumps, Jenkins Brothers' No. 88 Pump Valves are in use under 450 pounds pressure, and are proving themselves equal to every requirement.

We also manufacture a fine grade of Soft Rubber Valves for cold water and air service.

When ordering valves please state for what purpose you desire to use them.

Jenkins Brothers' Valves, Jenkins '96 Packing and Rubber Specialties received the highest Awards at the Pan-American Exposition

All the different specialties are stamped with Trade Mark.

Write for Catalogue

JENKINS BROTHERS

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